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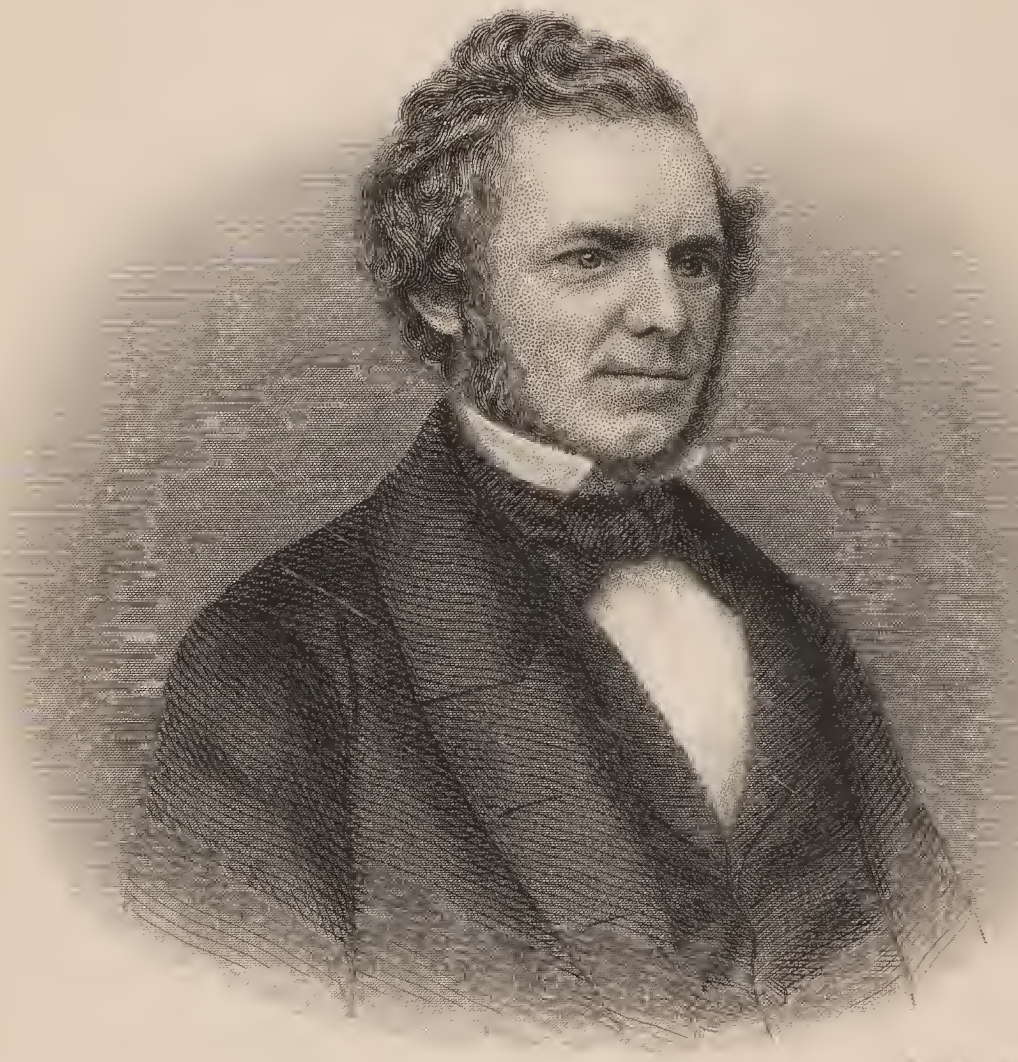

From a Photograph

Rich'd M. Hoe.

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Gould and Lincoln, Boston.

ANNUAL

OF

SCIENTIFIC DISCOVERY:

OR,

YEAR-BOOK OF FACTS IN SCIENCE AND ART

FOR 1856.

EXHIBITING THE

MOST IMPORTANT DISCOVERIES AND IMPROVEMENTS

IN

MECHANICS, USEFUL ARTS, NATURAL PHILOSOPHY, CHEMISTRY, ASTRONOMY, METEOROLOGY, ZOOLOGY, BOTANY, MINERALOGY, GEOLOGY, GEOGRAPHY, ANTIQUITIES, ETC.

TOGETHER WITH

A LIST OF RECENT SCIENTIFIC PUBLICATIONS; A CLASSIFIED LIST OF PATENTS; OBITUARIES OF EMINENT SCIENTIFIC MEN; NOTES ON THE PROGRESS OF SCIENCE DURING THE YEAR 1855, ETC.

EDITED BY

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NOTES BY THE EDITOR

ON THE

PROGRESS OF SCIENCE DURING THE YEAR 1855.

THE seventh annual and ninth regular session of the American Association for the Promotion of Science was held at Providence, R. I., during the week commencing with August 15th, Dr. John Torrey, of New York, President. The whole number of papers presented was 67: in Astronomy and Mathematics, 17; on Physics and Chemistry, 11; Geology and Mineralogy, 22; Zoology and Botany, 5; Meteorology, 3; Miscellaneous, 9.

The annual address, "On the History and Progress of Geology in America," was delivered by the retiring president, Prof. James D. Dana, of New Haven. The following officers were chosen for the ensuing year, Prof. James Hall, of Albany, President; Dr. B. A. Gould, Jr., of Cambridge, General Secretary; Dr. Elwyn, of Philadelphia, Treasurer. The next meeting was appointed to be held in Albany, N. Y., on the third Wednesday of August, 1856. An invitation was received from the Superintendent of the Military Academy at West Point for the Association to meet at that locality; this invitation was accompanied with a permission from the War Department to employ the property of the Military Academy for the entertainment of the Association.

On motion, it was resolved that invitations to attend the future meetings of the Association be extended to learned bodies and distinguished individuals in foreign lands.

A committee was also appointed, consisting of Profs. Agassiz and Dana, to memorialize the Legislature of New York on the subject of the artificial propagation of fish in the waters of that State.

Lieutenant Hunt, U. S. A., brought forward the subject of an Index of papers on Mathematical and Physical Science. He claimed that

works of this nature have been better appreciated by naturalists than by the mathematicians and physicists, as proved by that laborious work which the genius of Agassiz inaugurated, and which presents in four octavo volumes the titles of all known papers on Natural History and Geology up to its date. Mr. Hunt considered a similar index for the branches he indicated as equally necessary. In his experience as an assistant in the Coast Survey, he had on several occasions to make special investigations, in which it was desirable to examine all good relevant authorities and original memoirs. How to do this was the question. Mr. Hunt undertook, with the assistance and encouragement of the Superintendent of the Coast Survey (Prof. Bache), to furnish such an index as he conceived is demanded by the wants of scientific investigators. This index is intended to be included in the Coast Survey Report as an appendix. In prosecuting the labor, Mr. Hunt has already examined over a thousand volumes of memoirs, transactions, scientific periodicals, etc.

On motion the Association endorsed the plan of Lieutenant Hunt, and a resolution was adopted declaring the importance of such enterprises in advancing the interests of science.

The following resolution in respect to weights and measures was adopted: *Resolved*, That the committee on weights, measures, and coinage, be authorized to communicate with other associations or public bodies, or with individuals, in regard to the attainment of permanent uniformity in weights, measures, and coinage.

The subject of a new constitution for the Association came up by assignment at this meeting, and was discussed with much difference of sentiment. The consideration of the whole matter was finally postponed until the next meeting. Members, in the mean time were all invited to supply themselves with the draft of a new constitution, which was proposed at Providence by a committee appointed by the Association, and which may be obtained by application to the recording secretary, Prof. Lovering, at Cambridge, Mass. This new draft of a constitution, although not accepted by the Association, will probably form the basis of action upon this subject at the Albany meeting.

In this debate upon the constitutional revision, many of the members favored the abolition of all constitutions, and preferred that the Association should resolve itself into a simple annual convention of scientific men. The objections to the present constitution, and to the substitute proposed, seem to center in a dislike to the construction and power of the Standing Committee. The method in which this body has been organized, its arbitrary exercise of authority, its disregard of the constitutional requirement that the presiding officers shall be elected by ballot, have been sources of dissatisfaction from the

commencement of the meetings of the Association. At the meeting held in Washington, in 1853, it was proposed to increase the number of the Standing Committee to twenty-six; the constitutional draft submitted at Providence reduces the number to eighteen, and also provides for the creation of the office of Vice-President, while arbitrary power is placed in the hands of the Committee. It is to assign papers, arrange the business, suggest places and times of meeting, examine or exclude papers; appoint the Local Committee; nominate persons for membership; decide upon publications, etc., etc. Power like this should not be wielded by a limited number.

The meeting for 1855 was closed with a complimentary dinner given to the Association by the citizens of Providence, and presided over by Prof. Caswell, of Brown University.

The meeting of the Association at Albany for the present year will be in every respect most important and interesting. Upon the action which may be taken in regard to the constitution, and the future government of the Association, its harmony and prosperity will essentially depend. During the session of the Association also, it is understood that the new Dudley Observatory, founded and endowed by the munificence of the citizens of Albany, will be dedicated with suitable ceremonies. Many European *savans* have been invited to join in this inauguration; and Liebig, of Germany, and Airy, Astronomer Royal of Great Britain, have already signified their intention of attending. The discourse will be given by Hon. Edward Everett. At the same time, the new State Geological Hall, built by appropriations from the Legislature of New York for the reception of the splendid cabinet of geology and natural history belonging to the State, will be formally opened. Hon. W. H. Seward, under whose administration as Governor the Geological Survey of the State of New York commenced, and who wrote the introduction to the Natural History of the State, will deliver the oration.

The annual meeting of the British Association for the Promotion of Science for 1855, the Duke of Argyle, President, was held at Glasgow, Scotland, commencing September 12th. The meeting in every respect was eminently successful, and the attendance of British and foreign scientific men was unusually large. The whole number of papers read was 315, divided among the different sections as follows: in Mathematics and Physics, 47; in Chemistry, 60; in Geology, 42; in Zoology and Physiology, 62; in Geographical Science, 35; in Statistics, 31; in Mechanics, 38. Among the communications which excited the most popular interest was one by Colonel Rawlinson on Assyrian and Babylonian Antiquities and Ethnology, in which he described his gradual decipherment of the cuneiform inscriptions, and showed the great value of the information thus curiously obtained.

For the present year Dr. Daubeny was elected President, and Cheltenham appointed as the place of meeting. From the annual address by the President we derive the following memoranda. Alluding to the great telescope of Lord Rosse, he says:—"Its systematic operations may be said to be still only in the first stages of their progress; yet already how often do we see reference had to the mysterious revelations it has made, in discussions on the principles of that science, and in not a few of the speculations to which they are giving birth! Sir David Brewster, in his recent Life of Newton, has designated that telescope as 'one of the most wonderful combinations of art and science which the world has yet seen.' It must always be remembered, however, that astronomy is a science of which hitherto at least it might almost be said that one great genius had left us no more worlds to conquer; that is to say, he carried our knowledge at a bound to one grand, and apparently universal law, to which all worlds were subject, and of which every new discovery has been but an additional illustration. The reign of that law, whether universal or not, was at least so wide that we had never pierced beyond the boundary of its vast domain. For the first time since the days of Newton a suspicion has arisen in the minds of astronomers that we have passed into the reign of other laws, and that the nebular phenomena revealed to us by Lord Rosse's telescope must be governed by forces different from those of which we have any knowledge. Whether this opinion be or be not well founded—whether it be or be not probable that our limited command over time and space can ever yield to our research any other law of interest or importance comparable with that which has already been determined—still, inside that vast horizon there are fillings-in and fillings-up which will ever furnish infinite reward to labor.

"Of all the sciences, Chemistry is that which least requires to have its triumphs recorded here. The immediate applicability of so many of its results to the useful arts has secured for it the watchful interest of the world; and every day is adding some new proof of its inexhaustible fertility. It was to the British Association at Glasgow, in 1840, that Baron Liebig first communicated his work on the Application of Chemistry to Vegetable Physiology. The philosophical explanation there given of the principles of manuring and cropping gave an immediate impulse to agriculture, and directed attention to the manures which are valuable for their ammonia and mineral ingredients; and especially to guano, of which, in 1840, only a few specimens had appeared in Great Britain. The consequence was, that in the next year (1841), no less than 2,881 tons were imported; and during the succeeding years the total quantity imported into Great Britain has exceeded the enormous amount of 1,500,000 tons. Nor

has this been all: Chemistry has come in with her aid to do the work of Nature, and as the supply of guano becomes exhausted, limited as its production must be to a few rainless regions of the world, the importance of artificial mineral manures will increase. Already considerable capital is invested in the manufacture of superphosphates of lime, formed by the solution of bones in sulphuric acid. Of these artificial manures not less than 60,000 tons are annually sold in England alone; and it is a curious example of the endless interchange of services between the various sciences that geology has contributed her quota to the same important end; and the exuviæ and bones of extinct animals, found in a fossil state, are now, to the extent of from 12,000 to 15,000 tons, used to supply annually the same fertilizing materials to the soil."

The following is the conclusion of the address:—

"It is sometimes proudly asked, who shall set bounds to Science, or to the widening circle of her horizon? But why should we try to do so, when it is enough to observe that that horizon, however it may be enlarged, is an horizon still—a circle beyond which, however wide it be, there shine, like fixed stars without a parallax, eternal problems in which the march of science never shows any change of place. If there be one fact by which science reminds us more perpetually than another, it is that we have faculties impelling us to ask questions which we have no powers enabling us to answer. What better lesson of humility than this—what better indication of the reasonableness of looking to a state in which this discrepancy shall be done away—when we shall 'know, even as we are known!'"

The annual meeting of the German Association of Scientific Men and Physicians for 1855, called at Vienna, was postponed to another year, on account of the disturbances caused by the prevalence of the cholera in Germany.

The Scientific Congress of France held its twenty-second annual session at Le Puy, on the 16th of September.

Some time since, the British Association appointed a special parliamentary committee to inquire whether any measures could be adopted by the Government or Parliament, that would improve the position of science or its cultivators in this country. A report prepared by this committee, founded upon the opinions of various persons, eminent in science, has been published, and contains the following recommendations:—1. That reforms shall take place gradually in the system of any university which do not at present exact a certain proficiency in physical science as a condition preliminary to obtaining a degree. 2. That the number of Professors of Physical Science at the universities shall be increased, where necessary, but that, at all events, by a redistribution of subjects, or other arrangements, provision should

be made for effectually teaching all the various branches of physical science. 3. That professors and local teachers shall be appointed to give lectures on Science in the chief towns, for whose use philosophical apparatus shall be provided; and that arrangements shall be made for testing by examination the proficiency of those who attend such lectures. 4. That the formation of museums and public libraries in such towns, open to all classes, shall be encouraged and assisted; that all imposts shall by degrees be abolished that impede the diffusion of scientific knowledge; and donations of all government scientific publications be made by authority. 5. That more encouragement shall be given, by fellowships, increased salaries to professors, and other rewards, to the study of physical science. 6. That an alteration shall be made in the present system of bestowing pensions; some annuities in the nature of good-service pensions be granted; and additional aid be given to the prosecution, reduction, and publication of scientific researches. 7. That an appropriate building, in some central situation in London, shall be provided at the cost of the nation, in which the principal scientific societies may be located together. 8. That scientific offices shall be placed more nearly on a level in respect to salary, with such other civil appointments as are an object of ambition to highly educated men; that the officers themselves shall be emancipated from all such interference as is calculated to obstruct the zealous performance of their duties; and that new scientific offices shall be created in some cases in which they are required. 9. That facilities shall be given for transmitting and receiving scientific publications to and from foreign parts. 10. That a Board of Science shall be constituted, composed partly of persons holding offices under the Crown, and partly of men of the highest eminence in science, which shall have the control and expenditure of the greater part, at least, of the public funds given for its advancement and encouragement, shall originate applications for pecuniary or other aid to science, and generally perform such functions as are above described, together with such others as Government or Parliament may think fit to impose upon it.

During the continuance of the Great Exhibition at Paris, a meeting took place, composed of the members of the Imperial Commission, the jurymen and commissioners to the Exhibition, and the members of the late Statistical Congress, for the purpose of organizing an International Society, having for its object the promotion of a system of uniformity in weights, measures, and moneys. Baron James Rothschild presided. The four following resolutions were introduced and adopted:—

1. That it will be of the highest possible importance to encourage the publication in French of a work, giving in a clear and concise

form the history and a comparative table of the different systems of coins, weights, and measures, in the principal countries of the world, to be afterward translated and printed by the committees into the languages of all the countries represented in the Association.

2. That for this object, and to secure the perfect correctness of the work, the different committees composing the Association are requested beforehand to furnish all the information in their power relative to the coins, weights, and measures, of the country to which they belong, with the calculation of them on the metrical system, as a term of general comparison.

3. That each committee, in the country where it is constituted, shall employ all the means in its power, particularly those offered by the local press, to enlighten public opinion, and prepare for the meeting of an efficient International Congress, charged to solve the problem which constitutes the object of the Association.

4. That until such a congress shall be convoked, the members of the committee shall use all their efforts in order that, in the calculations and statistical tables, the value of the coins, weights, and measures, shall be accompanied by their reduction into coins, weights, and measures on the metrical system, in order to have a point of comparison common to all nations.

It was also resolved that a permanent International Committee should be immediately constituted at Paris, to be composed, as much as possible, of members of each of the countries represented in the Association.

The Council of the Royal Society has awarded the Copley Medal this year to M. Léon Foucault, for his various researches in Experimental Physics; and the two Royal Medals to Mr. John Russell Hind, for his discovery of ten Planetoids, the computation of their orbits, and various other astronomical discoveries; and to J. O. Westwood, Esq., President of the Entomological Society, for his various monographs and papers on Entomology.

The King of Prussia has presented a gold medal to Lieutenant Maury, U. S. N., on account of "the distinguished services which he has rendered to science and navigation by his labors in ascertaining the currents and depths of the ocean, and in determining the direction of the winds at different seasons and in different latitudes." This mark of distinction was also accompanied with the presentation of one of the gold medals struck in honor of the publication of Baron Humboldt's "Cosmos."

The Emperor of France has given 40,000 francs for the purpose of founding a new laboratory in connection with the High Normal School in Paris. It will be placed under the direction of M. Sainte-

Claire Deville, and will be confined to researches and analyses in mineral chemistry.

The following award of prizes was made during the past year by the French Academy:—The great Cuvierian Prize, which is only given to works of the first merit, was presented to M. Müller, for his Researches into the Structure and Development of Echinodermes, one of those works "which have contributed most to the philosophy of the science, to organogeny, zoology, and general physiology, since the death of Cuvier." This is the second time the Cuvierian Prize has been given, it having been awarded for the first time to Agassiz, for his work on Fossil Fishes. A prize of 2,000 francs was awarded to M. Berthelot, for his chemical researches on the fatty bodies. Medals were also decreed to all the astronomers who, during the year 1854, discovered planets—to MM. Luther, Marth, Hind, Ferguson, Goldschmidt, and Charcornac. Three awards were given for improvements in the processes used in Arts that are injurious to health—one for the substitution of potato starch for wood charcoal in preparing molds of clay for receiving copper, bronze, and melted cast-iron, proposed by a poor armorer, M. Rouy: a plan now generally adopted in the founderies of France, because it is not so hurtful to the workmen, although starch is dearer than charcoal powder. Another award was made to M. Mabru for a process for preserving milk in its natural state, which is simply this—tin canisters, having a small tubular opening, are filled full, and then kept for some time in a water-bath, to drive out all air, and finally hermetically sealed.

The following scientific researches are now in progress under the auspices and at the expense of the Royal (English) Society:—Researches on earthquake waves, by Robert Mallet; researches on the excretion of men and animals, by Dr. Marcet; experiments on the strength of materials, by Professor Hodgkinson; experimental researches on heat and magnetism, by Dr. Tyndall; experimental researches on the heat developed by the oxydation of certain metals, by Dr. Woods; experimental researches on fluids in motion, and on the thermal effects experienced by fluids in passing through small apertures, illustrating the typical forms of Foramenifera, by Dr. Carpenter; chemical researches on the solid oils and waxes of the vegetable kingdom, by Nevil Maskelyn, Esq.; experimental researches on the physiology of the blood, by Dr. Davy; experiments on the thermal effects of electric currents in unequally heated conductors, by Professor William Thompson.

The Imperial Geological Institution at Vienna has published a "Geologische Uebersicht der Oesterreichischen Monarchie," in which more than 2,000 localities, where mining establishments in Austria exist, have been named, and described.

The Palæontographical Society of London, which distributes among its subscribers a larger quantity of matter than any other publishing society, has issued a report, in which it announces an increase in its number of members to 762, and purposes to deliver the following works in the ensuing spring for the subscriptions of the last year: "The Fossil Reptilia of Great Britain," Part VI., by Professor Owen, containing 10 plates; "Fossil Shells of the Chalk Formation," Part III., by Mr. Sharpe, containing 10 plates; "The Mollusca of the Crag," Part IV., by Mr. S. Wood, containing 11 plates, and completing that work; "The Fossil Crustacea of the London Clay," by Professor Bell, containing about 10 plates; "The Entomostraca of the Tertiary Formations," by Mr. Rupert Jones, containing 6 plates; "The Radiaria of the Oolitic Formations," by Dr. Wright, Part I., containing 10 plates; "The Eocene Mollusca," by Mr. F. Edwards, Part IV., containing 10 plates.

Notwithstanding the terrible war in which Russia is at present engaged, matters of scientific interest are by no means neglected. Six large and thoroughly equipped geographical expeditions have left St. Petersburg during the past season. A chronometric expedition has also been made for determining the longitude between Moscow and Astracan; and the great measurement of the meridian arc which has been carried from Finland southward, is still going on at the latitude of 45°. The corresponding geodetic observations in Southern Russia are being vigorously prosecuted under the superintendence of General Wroutchekow.

A valuable donation to the Public Library of Boston has recently been made by the Superintendent of the London Patent Office, viz.: a complete set of all the publications relative to patents made by the commissioners of that office. This donation amounts to nearly two hundred volumes, imperial octavo; each volume of specifications being accompanied by a sheet imperial volume of lithographic illustrations.

The French Geographical Society have recently awarded a gold medal to each of the following English navigators and explorers: To Captain M'Clure, R. N., for his discovery of the North-west Passage; to Captain Inglefield, R. N., for his discoveries in the Arctic regions; and to Mr. Francis Galton, for his explorations in the Namaqua, Damara, and Ovampo countries, northward of the Orange River in South-west Africa.

The English Parliament have also voted a reward of 10,000 pounds to Captain M'Clure, his officers, and crew, for the discovery of the North-west Passage. Of this sum, 5,000 pounds is given to Captain M'Clure, who has also received the honor of knighthood.

Through the munificence of Mr. James Brown, the late eminent

Boston publisher, the Natural History Society of that city have received a valuable donation of rare and costly works relating to natural history, of the value of $2,000.

Nathan Jackson, Esq., of New York city, has presented $3,500 to the Lyceum of Natural History of Williams College, to aid in the erection of a building for scientific purposes.

According to a document read at a recent meeting of the Connecticut Historical Society, by Hon. Henry Barnard, the whole amount of land appropriated by the General Government for educational purposes, to the 1st of January, 1854, was 52,970,231 acres; which, at the minimum price of such lands when first brought into market, represented the munificent sum of $56,000,000—but which at this time could not be worth less than $200,000,000. The amount of the donations and subscriptions by individuals far exceeds all that has been given by State Legislatures. Mr. Barnard read from a table exhibiting the donations and bequests made by citizens of Boston within the last half century, amounting to upward of $4,000,000.

Two German travelers, who have recently returned from an extensive tour in America, Drs. Wagner and Karl Scherzer, are preparing for publication a work on the results of their joint labors—two volumes of which (those referring to Central America) are already in the press. Messrs. Wagner and Scherzer have wandered through North America, from the estuary of the St. Lawrence to that of the Mississippi—through the five republics of Central America, from Costa Rica to the northern frontier of Guatemala—and through the West India Islands of Jamaica, Hayti, and Cuba. The total length of their tour amounts to 30,000 miles, which they have made in not more than three years. Besides very considerable geological and botanical collections, the travelers have also brought together some thousands of vertebrate animals, mostly birds and reptiles, and about 50,000 specimens of invertebrate ones, the fourth part of which is said to consist of quite new species.

A new periodical has been recently started in London, called "The Quarterly Journal of Pure and Applied Mathematics," and devoted especially to this particular department of science. The title-page bears the names of J. J. Silvester, M. A., F. R. S., late Professor in University College, London, N. M. Ferrers, M. A., Professor Stokes, of Cambridge, F. R. S., A. Cayley, M. A., F. R. S., and M. Hermite, corresponding editor in Paris, an editorial staff affording sufficient guaranty for the manner in which the work will be conducted.

During the past year, Prof. Agassiz has announced the publication of a great work, entitled "Contributions to the Natural History of America," to be embraced in ten quarto volumes of about 300 pages, illustrated by twenty plates. The work will be the result of extended

researches during many years past, and will be the most complete proof of the rare scientific knowledge and abilities of its author which has yet been given to the public. It will contain the results of his embryological investigations, embracing about sixty monographs from all classes of animals, especially those characteristic of America; also descriptions of a great number of new species and genera, accompanied with accurate figures and anatomical details.

One of the most curious scientific books published during the past year has been a history of the Tineina, a species of microscopic moths, by Mr. H. T. Stainton, of England, who has devoted years to the study of their habit and characteristics. These moths are numerous in species, and extremely elegant in form and coloring, yet so minute in size, that entomologists have scarcely known until lately of their existence. The publication in question is to be executed on a scale of completeness and extended detail not hitherto reached by naturalists on any subject. The first volume published, of eight beautifully executed plates, with 350 pages of letter-press, contains the descriptions of only twenty-four species, and it will require forty such volumes to complete the work. The principal novelty of this work, however, consists in its being printed in parallel columns in four languages—English, French, German, and Latin. With these polyglot honors, the little night-flyers are raised to an importance surpassing far the lot of any other insects.

One of the most beautiful monographs ever issued in the United States, has been published during the past year by Isaac Lea, Esq., of Philadelphia, on the Fossil Foot-prints discovered by Mr. L. in the lowest beds of the Coal Formation, near Pottsville, Pa. The work is a large folio, and the plates represent the foot-prints of the oldest reptilian, known to palæontologists, of their natural size. Some attempts have been made to question the accuracy of the reference of these tracks to reptilian animals, and an opinion has been given by Prof. Agassiz that they are caused by fishes. Prof. J. Wyman, in a recent communication to the Boston Society of Natural History on this subject, stated that there is no known fish, recent or fossil, the pectoral or ventral fins of which could produce a series of tracks like those discovered in the coal strata of Pennsylvania by Mr. Lea. Although among Lophioid fishes the pectoral fins are used for locomotion on the shores, yet they in every instance conform to the fish type—are fins and not feet. An analogous condition of things is found among cetacean and marine saurians, where the limbs serve the purposes of paddles, and may be compared to fins, yet morphologically they can be referred only to the mammalian or reptilian types.

A new map of the Arctic Regions has been published by the British Admiralty, to which the names affixed to various localities by the

American expedition sent out by Henry Grinnell, Esq., have been adopted; and in particular, Grinnell's Land, discovered by said expedition, is entered conspicuously on the map, it having been on a previous map of the Admiralty called Prince Albert's Land. This act of justice to the exertions of our countrymen, has been for some time strongly urged by the Rev. Dr. Scoresby and other illustrious Arctic navigators.

The arrangements for securing a series of marine observations, according to the plans proposed and practically carried out by Lieut. Maury, have been completed by the British Government, and liberal appropriations granted by Parliament. A certain number of selected ships of the mercantile marine, and all those of her majesty employed in long or distant voyages, are, or soon will be, engaged in making exact observations with instruments supplied under the authority of the Board of Trade (duly tested and compared), and in registering the apparent results according to forms settled at the Brussels Conference of 1853, slightly modified, so as to suit present convenience. The estimates sanctioned by Parliament are sufficient to provide sixty merchant-ships and forty men-of-war with the necessary meteorological instruments (namely, barometers, thermometers, and hydrometers), in addition to the nautical instruments usual at sea; to pay office expenses and salaries (including allowances to agents at outports); and to provide the necessary registers. A captain in the navy is in charge of the office. Four subordinates are to assist him, and there are agents appointed at the principal ports to communicate personally with the owners, captains, and officers of ships. Liberally supplied by the United States Government, Maury's Sailing Directions and Charts are distributed gratis among those who undertake to record observations satisfactorily, and send them to the Board of Trade. Marks, expressive of distinction, are to be annexed to the names of approved contributors to meteorology in the Mercantile Navy List, and other encouragements are contemplated. Every exertion will be made at the office, not only to discuss and tabulate valuable observations, but to digest and render available as soon as possible such information as may tend immediately to the improvement of navigation.

A new society, called the "African Exploration Society," has been recently formed in England, with the object of exploring and evangelizing Central Africa from a station at Tunis. It proposes to seek its objects chiefly by means of a native African agency, specially trained for the purpose in an African school at Tunis, conducted by medical, scientific, and religious tutors from the United Kingdom. Tunis is well chosen as a station, because it is ready of access to the civilized world, and it is not in the same quarter from which other

operations upon Africa are proceeding. The agents will push southward from Tunis even to Timbuctoo and Soudan. Native agents will be trained to circulate the Scriptures, and at the same time to subserve the purposes of honest trade. The agents will be at once missionaries and examples of conversion—able to face the climate, able to converse on a level with those whom they propose to influence; and it is probable that by these simple means a species of black brotherhood will be extended through the continent, directly conducive to the spread of religion, incidentally, of constructing a machinery for the spread of civilization, of commerce, and of civilized transit.

It is proposed to open in London a "College of Domestic Economy," where every thing necessary to a perfect knowledge of the culinary art and other domestic matters will here be taught by a person of great experience and acknowledged ability. The students for practice will be divided into classes of four or five each, with a servant student to attend on each class, and assist them in their operations. Each class will provide what may be required for their practice, to be arranged by the student managing the class for the week, and the articles prepared will be consumed for their meals.

An excellent plan for promoting the social and sanitary condition of the working-classes in England, has been set on foot in the formation of museums for the exhibition of all objects bearing upon physical comfort and domestic economy, from the construction of dwelling-houses down to the minutest details of their furnishing. A society for this object also exists in Paris, under the name of the *Société d'Economie Charitable.* These museums will contain specimens of the most approved and cheapest kinds of furniture, household utensils, clothing, fuel, and other stores, besides models and plans of the external and internal arrangements of buildings of every description, workshops as well as dwelling-houses.

A valuable and interesting acquisition has recently been made by the Arundel Society of England, which furnishes the means of extending its agency to the illustration of a new class of artistic monuments. Three gentlemen, who have devoted much time to the study of mediæval art, have, with the permission of the owners, or guardians, of some of the principal private and public collections in England and on the Continent, made impressions, in gutta-percha, from several of the finest of the ancient ivory-carvings in their possession; and by employing these impressions as *matrices*, from which models or *types* for molding are produced, casts in what is termed "fictile ivory" have been subsequently manufactured, which preserve, to a great extent, the beauty of the originals. Duplicates of these casts have been placed on sale at a low rate by the officers of the Society. They are divided into classes, so as to exemplify, as far as possible, the charac-

teristics of the various ages and schools of this species of sculpture. The series, which numbers about 170 pieces, embraces examples from periods when monumental illustration from other sources is comparatively rare, and difficult to obtain; and, taken collectively, forms a compendious history of the sculptural art.

Under the authority of the State Medical Society of Vermont, a plan has been adopted for the registration of diseases with a view of thereby deducing general laws, which bids fair to yield most valuable results. A record-book has been prepared, to be used by every physician, and so arranged with printed captions, that an entry of every case in which the physician is called, with all its essential particulars, may be made in a moment's time, and with but little trouble. It is believed that such a collection of records will furnish much valuable aid in the history of epidemics.

During the past year measures have been taken to put into immediate working order the Dudley Observatory in the city of Albany. The history of this Observatory, which we have in a former volume adverted to, is as follows:—Some years since, a magnificent donation of land was given in the city of Albany by General Van Rensselaer for the location of an Astronomical Observatory, and for the erection and equipment of the building, Mrs. Dudley contributed $12,000. An equal sum in smaller subscriptions was also made up by the citizens of Albany.

The Observatory was erected under an understanding with Professor Mitchell, of Cincinnati, that when completed, he would take charge of it. While it was being erected Professor Mitchell embarked so deeply in railroad operations that he was unable to move to Albany. By reason of this event, unexpected to the founders, the Observatory has stood hitherto unoccupied. At the late meeting of the Scientific Association, at Providence, the matter came up for consideration, and the result is that the Observatory is to be fully equipped and placed under the charge of Messrs. Bache, Henry, Pierce and Gould, the resident astronomer being Dr. B. A. Gould. In addition to the amount already subscribed, Mrs. Dudley has also given $6,000 for the purchase of a heliometer, the construction of which was thus described by Professor Pierce at the last meeting of the American Association, "The instrument to be obtained is a heliometer of great peculiarity, its object-glass being divided into halves, so that each half gives a distinct image of every star to the observer. By separating the halves, therefore, the image of one star may be made to coincide with that of any other, and the distance of the halves of the object-glass will be the measure of the angular distance of the two stars. The same instrument may be applied, as its name indicates, to the sun. Its range is only about a degree. The construction of such an instrument requires

the nicest exercise of skill in astronomical instrument making. There are but two such instruments in Europe, one at Königsberg, used by Bessel in the measure of the sun and the triangulation of the pleiades; the other, which is a still more magnificent instrument, recently made by Repsold for the Radcliffe Observatory at Oxford, has not yet been put in use. It is with this instrument that Bessel has demonstrated that the stars have parallax and measured its amount. His instrument reads to hundredths of a second of an arc, and is accurate to less than a tenth of a second."

The sum of one thousand dollars has also been given by Erastus Corning of Albany for the construction of an Astronomical clock on a new plan proposed by Dr. Gould. A meridian circle, which it is expected will be the most perfect instrument of the kind, as well as equal in size to any hitherto constructed, has also been contracted for in Munich. Other instruments are in the process of completion, and it is anticipated that the Dudley Observatory will be fully equipped and in working order sometime during the present year.

Astronomer Broun, in the employ of the East India Company, in a letter to Colonel Sykes from India, which was read at the last meeting of the British Association, describes the successful establishment of an Observatory on the mountain Augustus Mullay, at 6,200 feet above the sea level, for the purpose of simultaneous record with the Observatory at Trevandrum. The difficulties of access to the summit of the mountain were so great, from having to cut paths through dense jungles, infested by elephants and other wild animals—from having to use ropes and mechanical aid in getting up the building materials, provisions, and the instruments—and in the delays from the laborers running away from fright and the effects of cold—that two years were consumed in the undertaking. The object of Astronomer Broun in making known his successful efforts in Europe is to enable observers to put themselves into communication with him, in case they should desire to have any experimental researches made on so novel a position for an Observatory.

Sir David Brewster, in his recent life of Sir Isaac Newton, thus adverts to the prospect of future astronomical progress and discovery:

"However great have been the achievements of the past, and however magnificent the instruments to which we owe them, the limits of telescopic vision have not been reached, and space has yet marvelous secrets to surrender. A *ten feet* reflector will be due to science before the close of the century, and a disc of flint-glass, twenty-nine *inches* in diameter, awaits the command of some liberal government, or some munificent individual, to be converted into an achromatic telescope of extraordinary power. In cherishing these sanguine expectations, we have not forgotten that the state of our northern at-

mosphere must set some limit to the magnifying power of our telescopes. In a variable climate, indeed, the vapors and local changes of temperature, and consequent inequalities of refraction, offer various obstructions to astronomical research. But we must meet the difficulty in the only way in which it can be met. The astronomer can not summon the zephyrs to give him a cloudless sky, nor command a thunder-storm to clear it. He must transport his telescope to the purer air of Egypt or India, or climb the flanks of the Himalaya or the Andes, to erect his watch-tower above the grosser regions of the atmosphere. In some of those brief yet lucid intervals, when distant objects present themselves in sharp outline and minute detail, discoveries of the highest value might be grasped by the lynx-eyed astronomer. The resolution of a nebula—the bisection of a double star—the detection of the smaller planetary fragments;—the details of a planet's ring—the evanescent markings on its disc—the physical changes on its surface, and perchance the display of some of the dark worlds of Bessel, might be the revelations of a moment, and would amply repay in national glory the transportation of a huge telescope to the shoulder or to the summit of a lofty mountain."

The result of the experiments recently made by Professor Airy of the Greenwich Observatory, in one of the deepest of the English coal-pits, for ascertaining the variation of gravity at great depths, have proved beyond doubt that the attraction of gravitation is increased at the depth of 1260 feet by $\frac{1}{19000}$ part.

During the past year, another very important astronomical work has been performed, by which the difference of longitude between Paris and Greenwich has been ascertained. The number of days considered available for longitude, in consequence of transits of stars having been observed at both Observatories, was 12; and the number of signals was 1,703. Very great care was taken on both sides for the adjustment of the instruments. The resulting difference of longitude, 9′ 20″ ·63, is probably very accurate. It is less by nearly 1″ of time than that determined in 1825 by rocket signals under the superintendence of Sir John Herschel and Colonel Sabine. The time occupied by the passage of the galvanic current appeared to be one-twelfth of a second.

In his annual Report, the English astronomer royal regrets that, while the Greenwich astronomical observations have assumed such a shape that the astronomer will find all the moving bodies of the solar system presented in the utmost extent and accuracy, the same assertion can not be applied to the magnetical and meteorological observations; not, however, from any defect in the instruments or observations; for these have acquired an extraordinary excellence and precision, particularly in the photographic branch of registration. "But," to use the

words of the Report, "after having obtained the immediate results of observation, with the utmost completeness and exactitude, we are absolutely stopped from making further progress by the total absence of even empirical theory." At the same time, the system and extent of the observations continue unaltered. For the three magnetic elements, and for the barometer and the dry and wet thermometers, eye observations are made three or four times daily; and these serve as zeros both in time and in measure for the curves formed by continuous self-registration on the photographic sheets. Thus, whenever any extended view of the cosmical causes or laws of magnetism and meteorology shall render an accurate discussion of these phenomena practicable, those made at Greenwich will be found to present such materials for the investigation as can scarcely be obtained at any other Observatory.

The ozone observations which were started some time since in Great Britain, and which have been accurately kept by numerous observers in all parts of the kingdom, have not led to any deductions of value to science; it is curious, however, to discover that in large towns, such as London and Manchester, no ozone is developed, even when it is found to exist abundantly in the neighboring country, and especially so in proximity to the sea.

It is well-known that great doubt has hitherto been cast upon the narrative published some years since, by M. Caillé of France, describing his travels in Africa, and visit to the city of Timbuctoo. The experience of Dr. Barth, the African traveler, however, leave no doubt that M. Caillé was truthful in all essential particulars. It was in April, 1828, that Caillé arrived at the African city, his starting-place having been Sierra Leone; and he endured frightful privations and sufferings on the way. He is said to have been the first European who ever penetrated the mysterious Timbuctoo, and his stay in it only lasted fourteen days. Hardships, combined with the bad effects of the awful climate, produced disease, and he returned to France in a dying state, and died shortly after. He was only thirty-nine years of age when he was cut off.

A letter has been recently published in the *N. Y. Tribune*, from the Abbé Bourbourg, a Catholic priest in Central America, in which he claims to have discovered in Guatemala the remains of various antique cities of great magnitude and solidity; also, some most precious monuments of the language and history of the aboriginal people, long anterior to the arrival of the Spaniards. What will be the most surprising to scholars, and will doubtless be received with some incredulity, is the assertion of M. de Bourbourg that these languages contain undeniable relics of various Scandinavian and Teutonic tongues. Danish, Swedish, English, and even some Oriental words, are said to be found in great distinctness and purity mingled in the early dialects of the

country, while the Indian traditions declare that their ancestors migrated from the north-east, by sea, through mist and snow. From these philological remains and traditions, M. de Bourbourg concludes that there was a migration into the country from the settlement of the Northmen in Massachusetts. If true, this is a most interesting contribution to the history of the American continent, and the public will wait with impatience for that more complete account of it which M. de Bourbourg intends to lay before the world, with the documentary evidence sustaining his conclusions.

Professor A. Retzius of Stockholm, Sweden, in a communication addressed to the Philadelphia Academy, shows most indubitably that the practice of compressing the skull artificially, which was supposed to be peculiar to the aboriginal inhabitants of America, was practiced by the ancient Huns, and probably by some other nations of antiquity occupying Eastern Europe and Central Asia.

During the past summer a portion of the U. S. North-Pacific surveying squadron cruised in the Arctic Seas, northwest of Behring's Straits. It was the intention of Lieutenant Rodgers to visit the land reported to have been discovered by Captain Kellett, of the expedition sent out by the English government in 1851, in search of Sir John Franklin; and as the weather indications were favorable to this end, the course of the vessel was shaped accordingly. The position of this land, as reported by Captain Kellett, was about sixty miles to the northward of Herald Island. The "Vincennes" reached the latitude of 72° 05′ 29″, in longitude 174° 37′ 15″—a higher point than ever before reached, having sailed over the assumed position of Captain Kellett's land; and Lieutenant Rodgers was forced to the conclusion that Captain Kellett had fallen into the common error in these latitudes of being deceived by low cloud-banks. At this point the progress of the vessel was interrupted by a barrier of ice, and as the vessel was not prepared for winter quarters in these regions, it was deemed advisable to alter her course. Returning by the west of Herald Island, the "Vincennes" sailed over the tail of Herald reef, and worked up to the position of the land reported by Captain Kellett, and named "Plover Island." This land was reported by Captain Kellett as having been seen in foggy weather; and here again he must have been deceived by clouds, as no land could be found by the "Vincennes," although with every advantage of fine weather for observation.

An expedition has recently been sent by the Dutch government to the Arctic Seas, to commence an investigation into the nature of oceanic currents, according to the system and plan proposed by Lieutenant Maury.

During the past season, the American Exploring Expedition under Lieutenant Page, U. S. N. in Paraguay, have ascended the branch

of the Parana, or La Plata, known as the Salado, a distance of 360 miles. The Salado empties into the Parana at Santa Fé, the principal town of the province of that name which is one of the Argentine Confederation. The Salado has never heretofore been either ascended or descended to this point, and the practicability of its navigation was a problem unsolved until this exploration. It is the most important river in the Argentine Confederation, and is the natural outlet for the products of Salta, Tucuman, Santiago, Mendoza, Cordova, and Santa Fé; but the apprehension of encountering insurmountable obstacles, and the fear of the Indians, have deprived the inhabitants of those provinces of its benefits ever since the first settlement of the country. The region of country through which the expedition passed is represented to be beautiful in scenery and well wooded. The character of the soil is alluvial, based on argillaceous substratum, and it is said that all that is wanted to transform this wilderness of country into a garden is the hand of civilized man. The government, aware that the resources of this productive country can be developed only by the introduction of a foreign population, holds out to immigrants the most liberal inducements.

The geological survey of New Jersey has been continued during the past year with great vigor. The enhanced value of land in certain districts arising from the discovery of new localities of peat, calcareous marls and green-sand, will, it is said, more than equal the cost of the survey.

Further evidence respecting the fate of Sir John Franklin, confirmatory of the statements made by Dr. Rae last year, has recently been obtained through the agency of an expedition sent out by the Hudson Bay Company. This party left Carlton House, 54° north latitude, February 7th, 1855, and descending the Great Fish River, reached its estuary into the Arctic Sea on the 30th of July. Here they met with Esquimaux, who corroborated the reports of Dr. Rae, and directed them to Montreal Island, a short distance from the mouth of the river, as the spot where, according to their instructions, they were to commence minute exploration. From this time until the 9th of August, the party were industriously engaged in searches on the island, and on the mainland, between 67° and 69° north latitude. At last, on Montreal Island, where their explorations commenced, they found snow-shoes known to be of English make, with the name of Dr. Stanley, who was surgeon of Sir John Franklin's ship, the "Erebus," cut in them by a knife. Afterward, they found on the same island a boat belonging to the Franklin expedition, with the name "Terror" still distinctly visible. Among the Esquimaux were found iron kettles corresponding in shape and size with those furnished the Franklin expedition, and bearing the mark of the British government. Other

articles known to have belonged to the expedition, were obtained from the Esquimaux, and brought by the party for deposit with the British government.

The report of the Esquimaux was, that one man died on Montreal Island, and that the balance of the party wandered on the beach of the mainland opposite, until worn out by fatigue and starvation, they, one by one, laid themselves down and died too. No papers or books, and no human remains, were found; nor was it likely, as four years had elapsed since this tragedy was enacted upon a low sandy beach, exposed to the storms of four Arctic winters; and there is little doubt that either the sea has washed off, or the sand has buried deep, the unfortunates who perished on this spot.

A measure has recently been put in operation by the English Admiralty, which could also be adopted with profit in the United States. The Crimean war, having shown by a painful and costly experience, the necessity of employing better educated men for government offices of trust and responsibility, it has been ordered that no person shall be appointed to any post in the civil department of the British Admiralty without previously passing a strict examination in all the branches of a good English education, and in Latin or some modern language. It is also understood that similar regulations will also be adopted in all the other departments of government service.

We present to our readers for the present year, the portrait of Col. R. M. Hoe, of New York, distinguished for his many and important improvements of the printing-press.

In order to illustrate the progress of Discovery and Improvement in the various Departments of Science pertaining to Agriculture and Rural Economy, more fully than the limits of the "Annual of Scientific Discovery" will allow, the Editor has recently published a separate volume arranged upon a similar plan, entitled the *Year Book of Agriculture, or the Annual of Agricultural Discovery and Improvement for* 1855–6. To those of our readers who are desirous of a more complete report of scientific progress for the past year, in these special departments, we would refer to the above-noticed publication.

All communications intended for the Editor of "Annual of Scientific Discovery," or the "Year Book of Agriculture," should be addressed to the care of G. P. Putnam & Co., 321 Broadway, New York.

THE

ANNUAL OF SCIENTIFIC DISCOVERY.

MECHANICS AND USEFUL ARTS.

SUBJECTS FOR INVESTIGATION AND PREMIUM.

During the past year the London Society of Arts published a list of subjects, *desiderata* in the various branches of science and art, which they considered worthy of investigation, and for the best communication respecting which, sent to the Society, they proposed to award a premium. As it is a matter involving no little labor and knowledge to select, and explicitly set forth, reasonable problems and inquiries relating to the industrial arts, and believing, as we do, that at the present day, a great part of every invention consists in finding out what is really needed, we copy some of the most important of the subjects propounded by the Society; and for the best account or treatise respecting which premiums are offered. To indicate and point attention to a want is, at any rate, the most effectual way of supplying it.

For an essay on ancient metallurgy.

For an account of the modes by which *wolfram* can be separated from other ores; and on the uses of tungsten in the arts.

For any new application of tungsten in arts or manufactures.

For an account of menachanite or iserine; and suggestions for obtaining titanium from these ores.

For any improvement in the process of condensing the fumes in the smelting of lead slags.

For an account of the best proportions for the production of the compound metal, bronze; and the preparation of bronze washes.

For the invention of a white metallic alloy, free from microscopic faults, which may be successfully applied to the arts; is hard enough for use in reflecting telescopes, and is not liable to be acted upon by the atmosphere.

For the discovery or manufacture of a new smokeless fuel, which shall not occupy more space, or be of greater weight than the fuel now in use; and

shall be equal in the amount of heating power, without liability to injure metals in contact with it.

For an account of the processes employed in obtaining different products, as parrafine from shale, and the uses to which they may be applied.

For an account of the economic manufacture of color by electricity.

For the preparation of any color, applicable to the japanned surfaces of papier maché, that shall be free from the brightness (or glare) of the varnished colors now used, but yet possess the same degree of hardness and durability.

For the preparation of light colors to be used in enameling or japanning slate or iron, that will stand the action of heat from the fire without blistering or discoloration, and be sufficiently hard to resist scratches.

For an account of the processes involved in the preparation of animal charcoal, and its recent applications to manufacturing and other purposes.

For the best essay on the theory and practice of fermentation, particularly as applied to the art of brewing, so as to modify, or altogether dispense with the intermediate process of malting.

For a substitute for, or preparation of, yeast for raising bread, that may be preserved for use, better than any hitherto generally known.

For improvements in the processes for preserving animal food, and for preventing salted and other provisions from becoming rancid, with an account of methods at present employed.

For the discovery, and production to the Society, of any new substance which can be successfully used as a substitute for gutta percha.

For the production of a perfectly colorless copal varnish, not liable to injure the colors over which it is applied.

For the production of a colorless gold size, not liable to affect the delicate tints with which it is mixed when used to facilitate their drying.

For a pure colorless oil, suitable for artists; or for a decolorizing agent for linseed oil, which will leave its other properties unimpaired.

For the production of cheap purple and yellow lakes, of good quality, suitable for carriage-builders, etc., and not liable to fade or change color.

For the importation of, at least, two tons of any new vegetable fiber, applicable to all the purposes for which flax or hemp is now used, and equally strong and durable.

For the discovery of an economic and effective substitute for the teazels used in raising the face, or nap, of cloth.

For a method of preparing an engine size for the use of paper-makers, superior to any now in use.

For the best account of the mode in which size from sea-weed is prepared and used by the Chinese.

For the best series of useful products from sea-weeds, the methods of obtaining them, and the purposes to which they are or may be applied.

For an effectual method of utilizing the sewerage of towns.

For an account of the mechanical means at present in use to facilitate the operation of packing goods, whether by hydraulic presses or otherwise.

For the best form of street goods wagon; the improvements required are a lower center of gravity, and a ready means of discharging heavy packages.

For an elastic material for tubing suited to the conveyance of gas, and not liable to be affected by alterations in temperature, or to be acted upon by the gas itself.

For improvements in the oxy-hydrogen microscope, and the means by which a bright object may be presented on a dark ground.

For a rapid means of reproducing artistic designs or sketches, without the intervention of hand labor, for surface printing by machinery.

For a means of producing impressions from copper-plates by machinery, without the intervention of hand labor.

For the invention of a simple electrometer, to be sold at a moderate price, for determining the amount and kind of atmospheric electricity; and which will show uniform results under uniform circumstances.

For the invention of a marine mercurial barometer, which will obviate the oscillation of the mercury, and fulfill all the conditions necessary to make it a good and reliable instrument; and be sold at a moderate price.

For the invention of an anemometer for determining the direction of the wind, and its pressure in pounds on the square foot, to be sold at a moderate price.

For the invention of an anemometer for measuring the force and direction of the wind on board ship correctly, distinguishing the amount due to the wind and that due to the ship's velocity, varying with the angle.

For an instrument that will detect the local attraction of a ship at sea, with reference to the compass, by direct observation of the heavenly bodies, *without* the process of turning the ship.

For the production of a lustrous wool, to be used in lieu of silk, in the manufacture of fringes, carriage laces, etc.

For the successful application of some new means (as electricity, or photography, for instance) for producing ornamental designs in woven fabrics, which shall be cheaper, and easier of application, than those at present employed.

For an efficient means of removing the fatty matters from skins, so as to render them capable of receiving mordants by the ordinary printing process.

For the best mode of dressing kid for the upper leather of boots; the improvements required are, strength of the grain and a good firm black dye.

For the best specimens of cisterns, suitable for household or other purposes, made of glass in one piece.

For a chair or couch affording the greatest possible amount of support to persons of weak physical powers while writing.

For a means of rendering the plaster used for casts, less absorbent, and more adhesive, so as to facilitate its use for repairing purposes.

For the best means of turning to useful account, slag of furnaces, in a coarse, refined, or combined state.

For the best design for a flower trough or vase, ornamented in bas-relief, and capable of being cast from a mold in one piece, and of being produced in terra cotta.

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SUBMARINE TUNNEL BETWEEN ENGLAND AND FRANCE.

M. Favre, a distinguished French engineer, has recently brought before the public an extraordinary plan for constructing a submarine tunnel under the channel from France to England; and what is no less extraordinary, the enterprise finds supporters, and may be considered as seriously entered upon. The length of the proposed tunnel will be about 18½ miles in length, to which must be added about 1½ mile that will run under the shore on each side in order to give the necessary gradual ascent from the tunnel to the surface of the earth. The distance between the top of the arch of the tunnel will be less than 27⅓ yards, so that all danger of the ocean breaking through will be avoided by this enormous thickness of what may be called the wall of the tunnel. This tunnel will be lined with a double arch, the first of granite and of impermeable cement, the second of thin iron plates pierced like a colander with small holes, so that the slightest leakage will be instantly discovered. Through this tunnel it is intended that an atmospheric railroad shall be established, thereby avoiding the smoke consequent on the use of the ordinary locomotive, by which the transit from end to end will be performed in 27 minutes. The natural objection which arises to the practicability of this stupendous work is the difficulty of getting rid of the earth and stone quarried out of the bowels of the subterranean chamber. In the ordinary course of engineering, every barrow-load of earth would have to be brought to one of the mouths of the tunnel, which operation would consume so much time and labor as to add enormously to the expenses. This difficulty M. Favre proposes to surmount by sinking along the course of the tunnel what he calls "Maritime Wells," which will divide this subterranean gallery into sections of about 11,000 yards each in length. By these wells all the encumbering earth will be thrown into the sea, forming islands about the wells themselves, and so strengthening them. These wells will serve the purpose of ventilating the tunnel. The cost of the whole is estimated in round numbers at 100,000,000f., or $20,000,000, and the cost of each yard will be 2,695f., or $539. The soundings that have been made in the English Channel, show that the soil is very favorable to such an undertaking. At a certain depth freestone has been found, so that the vault of the tunnel will be formed of a stone impermeable to water, and capable of sustaining, in a thickness of 27 yards, an enormous weight.

The estimates of the produce of this submarine railway, are based on the supposition that 200,000 passengers now travel backward and forward between France and England at the present day. Of course this number would be increased by the facilities offered by the submarine railway. France now consumes 80,000,000 of metrical quintals of pit coal, 8,000,000 of which is furnished by England, the remainder by Belgium and Prussia. As the superior facility for transport would enable England to supply much of this coal now brought from those countries, the Company calculate that their transport of coal will amount at least to 10,000,000 of tons, which will yield a profit for transport of 10,000,000 of francs yearly for this branch of commerce

alone. Besides, the 3,000 ships that now annually enter the harbors of Calais, Boulogne, and Dunkirk, with a tonnage of 40,000 tons, will, of course, yield a great portion of their traffic to this railway, which will be safe, expeditious, and comparatively inexpensive.

Engineers are at present engaged making surveys and soundings for the purpose of estimating, as accurately as possible, the utmost cost, and contractors, offering guarantees of responsibility, are ready to take work.

The following is the conclusion of a recent report on the subject:

"In conclusion, we are impressed with the conviction that we have proved, not only that this project is possible, but that it will be comparatively easy to construct a railway under the Channel. We have now developed our system of maritime 'wells,' which would divide the subterranean tunnel into different sections. Our plan of a double vault would give as ample securities as any of the ordinary railways possess. The tunnel would set aside the arm of the sea which separates France from England. It would bind, upon the most solid foundation, the Continent with Great Britain, which is at present isolated from the rest of Europe. Our project has been received every where with the most lively sympathies, and an Anglo-French Company will be immediately organized upon the most powerful basis to execute the railway of Calais."

NEW METHOD OF REPAIRING A SHIP WITHOUT DOCKING.

The immense British screw steamer, Himalaya, having become seriously damaged in the Black Sea, it became requisite that repairs should be made at Malta. There being no dry-dock at the place of sufficient capacity to receive her, this difficulty was surmounted in the following manner: The Himalaya is an iron vessel, constructed on the life-boat principle, with water-tight compartments. She was taken into the dock about noon, and water introduced into her fore compartment with syphons, for about two hours. At that time a powerful purchase was fixed aft to four derricks, and hove taut, when she started up 18 inches. Three hours later the purchase was hove again, when she moved up 12 inches, and so continued until half past eleven P. M., when it was found that the shaft-hole of the propeller was 15 inches out of water. At this time her immersion was 7 feet 10 inches aft, and 27 feet forward, with about two feet of water under her forefoot; and this was accomplished so easy that persons witnessing the operation almost doubted their own eyes. She strained nothing whatever, and when her defects had been made good, she was let down, the water in her fore-compartment pumped out, and in 12 hours she regained her natural position. It will be seen that she was waterborne the whole time, and that by destroying the buoyancy forward the assistance she required aft to raise her was comparatively small. This operation, probably, would answer only for an iron vessel, inasmuch as any wooden vessel, as ordinarily constructed, would be found deficient in longitudinal strength.

The Nautical Magazine, in this connection, also recalls to remembrance an ingenious plan adopted some years since, at the Navy Yard at Norfolk, for

repairing a vessel without docking. The United States' ship of the line, Delaware, immediately after launching, lost a portion of her copper. There being no government dry-dock at that time, the ship was allowed to remain in that condition until orders came to fit her for sea, when, in order to make her outfit as complete below as above water, Mr. Broadie, the foreman of the yard, proposed and obtained leave to make a box, with open top and side, to cover the part to be repaired, one side to fit the side of the ship. The locality of the spot from which the copper was removed being known, there was little difficulty in preparing timbers of the shape of the side of the vessel, upon which a box, or diving-bell, was projected, of sufficient size and strength to sustain the pressure of the water from without when the water from within was removed. When finished, the edges, coming against the side of the ship, and forming the margin of the open side, were padded with canvas, so as to be brought close to prevent the passage of the water, and the whole fabric being provided with ring-bolts, for securing the box to its place, by means of ropes passed under the keel and up the opposite side, in like manner it was secured firmly fore and aft; and when thus made fast, the water was pumped out, and workmen went down to the place, when the copper and worm-eaten plank were removed, a new plank inserted, fastened, caulked, and re-coppered. All this while the ship was afloat, and the defective part from 15 to 18 feet below the surface of the water. The ship went to sea and performed the usual cruise of three years, more or less, and Mr. Broadie was awarded $500 by Congress, for his mechanical skill.

IMPROVEMENTS IN SHIPS AND STEAMERS.

Cunard Steamship Persia.—During the past season, a new iron steamer, the Persia, has been launched by the Cunard Steamship Company, at Glasgow, Scotland. This vessel, at present, is the largest steamer afloat, far exceeding in length, strength, tonnage, and steam power, the Great Britain or the Himalaya, and exceeding also by no less than 1200 tons the internal capacity of the largest of the present splendid Cunard liners. Her chief proportions may be summed up as follows:—

Length from figure-head to taffrail	390 feet.
Length in the water	360 "
Breadth of the hull	45 "
Breadth over all	71 "
Depth	32 "

Stupendous as the Persia is, the lines of beauty have been so well worked out in the preparation of her model that her appearance is singularly graceful and lightsome. Yet this mighty fabric, so beautiful as a whole, is made up of innumerable pieces of ponderous metal, welded, jointed, and riveted into each other with exceeding deftness. The keel consists of several bars of iron about 35 feet in length each, joined together by long scarfs, and as a whole 13 inches deep by 4½ inches thick. The framing is constructed in a manner at once peculiar, and securing the greatest possible amount of strength.

The iron stern-post is 13 inches in breadth, by 5 inches in thickness, carrying the rudder, the stock of which is 8 inches in diameter. The framing of the ship is very heavy. The space between each frame is only 10 inches, and the powerful frames or ribs are themselves 10 inches deep, with double angle irons at the outer and inner edges. The bow is constructed in a manner at once peculiar and affording the greatest possible strength to this important part of the ship. The framing is placed normally to the stern, the effect of which is that, in the case of collision with other ships or with rocks, or icebergs, the strain would fall upon the very strongest material within the structure. The plates or outer planking of the ship, so to speak, are laid alternately, so that one adds strength to the other, and they form a whole of wonderful compactness and solidity. The keel plates are $\frac{11}{16}$ of an inch in thickness; at the bottom of the ship the plates are $\frac{15}{16}$ of an inch in thickness; from this section to the load water line they are $\frac{3}{4}$ of an inch, and above this they are $\frac{11}{16}$ of an inch in thickness. The plates round the gunwale are $\frac{7}{8}$ of an inch in thickness.

The Persia has seven water-tight compartments. The goods are to be stowed in two of these divisions. These goods' stores, or rather tanks, are placed in the center line of the ship, with the coal cellars or bunkers on each side of them. At the same time, the vessel is so constructed as to have in reality a double bottom under these goods' chambers—so that if the outer were beat in or injured, the inner would, in all likelihood, protect the cargo dry and intact. The chambers are perfectly water-tight; and in the event of accident to the hull, these tanks would of themselves float the ship.

Steamer Ocean Bird.—About three years ago the project of establishing a line of European steamers from New York, to make the passage across the Atlantic to the nearest port on the coast of Ireland, within one week, was broached by Mr. William Norris, an eminent engineer of Philadelphia, who, together with several distinguished gentlemen of New York, commenced the enterprise. Mr. John W. Griffiths (now editor of *The Nautical Magazine*), marine architect of New York, was instructed to build a steamship capable of going 20 nautical miles an hour, that would accommodate from 60 to 80 passengers, and coal enough for 3,000 miles of steaming, at a cost of not more than $120,000. Mr. Griffiths submitted his plans for a steamer capable of attaining this speed, with a mean draught of water of 7 feet, so modeled that she would lift her bows over the wave instead of cleaving it, and be sustained by the middle of her length rather than by the ends, thus removing the main cause of pitching or divergence from the horizontal position, and enabling the hull to glide over instead of cutting through the water. The plans were approved, the work progressed satisfactorily toward completion, and the vessel was nearly ready for launching, when the failure of Mr. Norris brought her under the hammer of the United States Marshal. The present owner not choosing to complete her according to this original plan, Mr. Griffiths declined proceeding with her construction, and she was consequently finished by other parties, with modifications. These consisted in a reduction of five per cent. of the propelling power, the addition of another deck weighing 194 tons, making four decks altogether, and a curtailment of three feet in the

diameter of the paddle-wheels. These alterations sink the hull 18 inches deeper than was originally calculated for, besides presenting a much larger amount of surface for atmospheric resistance. Her dimensions, as completed, are 222 feet on the load line, 225 feet on deck, 36 feet 10 inches beam, and 22 feet hold, or 7 feet deeper than her hull was designed for. The machinery is proportioned as follows;

Diameter of cylinder	65 inches.
Stroke of piston........................	12 feet.
Diameter of wheels.....................	33 "
Length of bucket........................	7 ft. 9 in.
Breadth of bucket......................	22 inches,
Number of buckets.....................	28 "
Dip of bucket...........................	4 ft. 9 in.

She is furnished with four single-return flue boilers, two forward and two aft. Both of the forward boilers are 20 feet long, and the after two 22 feet in length. Width of boilers 9 feet 6 inches, and 10 feet 2 inches in height. The entire fire surface is 4,500.44 superficial feet. On the trial trip this steamer (named the Ocean Bird) averaged 17 revolutions a minute with 23 lbs. of steam, running 17 miles an hour against a three-knot tide and a strong head wind, or equal to 20 miles an hour in smooth water. The bow of this vessel possesses great lifting power, causing the waves to pass under the hull instead of being broken by the abrupt termination of the globular line. Her hull is molded to a hollow water-line at both ends, and thus the external pressure is perfectly equalized.

Novelties in Ship-building.—The *Cork* (Ireland) *Reporter* thus describes a ship of somewhat novel construction:

A large ship, with an auxiliary screw propeller, now lies in our harbor, built on a new and curious principle, on which, we believe, she is the first constructed. She is wholly of wrought iron, being framed and put together in the same manner as the Britannia Tubular Bridge, without knees or timber work of any kind in her hull. A plank deck is laid over the iron one, and on this are a couple of large deck houses. Instead of stowing ballast in the usual way, she is provided with water-tight compartments in her hull, into which water can be pumped, for ballast, to any extent required. Her heavy tackle is worked by steam machinery, superseding the necessity for a large amount of manual labor. Owing to the absence of timbers, beams, etc., she has stowage for 900 tons of cargo, though measuring little over 400 tons —no inconsiderable advantage in itself. Externally her appearance is very singular, from the convexity of her sides; in nautical phrase, she "tumbles home" aloft in a most unusual manner.

For the purpose of facilitating operations in the Black Sea, the British government have recently fitted up two large screw steamers, one as a flour-mill and biscuit-bakery, the other for engineering purposes. This last vessel contains a large workshop between decks, fitted with the best tools obtainable, consisting of drilling, punching, shearing, shaping, and slotting apparatus, and two circular-saw benches, besides smiths' forges with fan blasts, and

a cupola for iron and brass casting. The ship's engine and a ten-horse portable engine supply the necessary power for driving the tools.

Improved Rudder.—In an improvement recently patented by J. S. Robbins of San Francisco, two rudders are employed to steer the vessel. One of them is attached to the stern-post in the usual manner; the other placed directly behind the first, and secured in an iron frame which projects back for that purpose. The two are connected together with arms in such a manner that the force of the water, when it comes in contact with the after rudder, will assist the helmsman in moving the post rudder, so that they counterbalance each other. This it is said reduces the labor of steering to almost nothing, gives complete steadiness to the wheel, and enables a single man, or even a boy, to guide the largest vessel in the fiercest storm, with perfect ease.

India Rubber Lining for Vessels.—A plan has been patented by Mr. V. P. Corbett, of New York, for lining vessels with a continuous coating of India rubber, as a safeguard against leakage. It is intended to apply the lining within the frame of the ship, and beneath the ceiling. A large proportion of the accidents that occur to the hulls of vessels are from striking the bottom in such a manner as not to actually displace, or rather destroy, any portion, but only to strain and split the wood. The whole reliance being on the integrity of the exterior shell, it follows that the starting of a few planks creates a furious leak, and unless the pumps are capable of controlling the evil, the ship is lost. With a gum lining, however, the leak would merely fill the spaces between the frames, and the interior of the hold would remain as dry as before. The edges of the sheets, which are proposed to be from $\frac{1}{4}$ to $\frac{5}{8}$ of an inch in thickness, are to be cemented by heat; and the gum, it is believed will be as durable as the wood itself.

A patent for improvement in propellers was granted Chas. de Bergue of London, June 9th. In this improvement the propeller somewhat resembles a rocking arm or blade, working in a chamber open at each extremity, one on each side of the vessel, as a substitute for, and in the place of, the common paddle-wheel. It is connected by a rod to a crank on the extremity of the main shaft of the engine, and it thus receives a vibrating treading motion, the action being somewhat like that of a fish's tail: it is all under water except the crank, and part of the connecting rod.

Improved Screw-Propelling Engines.—Mr. Salter, of London, has introduced a new arrangement of steam-engine, particularly adapted for screw-propeller navigation. It may be considered a semi-rotary, reciprocating engine, having two curved cylinders, the pistons of which, at every stroke, travel over a segment of a circle; and the piston-rods being connected by toggle-joints to the crank on the screw-propeller shaft, each revolution is effected with a minimum amount of friction. The valves are so arranged that the induction port opens very small, allowing the injection only of a puff of steam, while at the end of the stroke the exhaust-valve opens to the fullest extent, giving instantaneous freedom to the return-stroke of the piston.

Side Screw Steamers.—The steamer Baltic, of Lake Erie, once a paddle-wheel boat, was divested of her paddles and engines last year, and has been

propelled during the present season with side screws—one at each side, and two short-stroke, high-pressure engines, connected by direct application to the cranks. It has been running—in connection with the New York Central Railroad and Lake Erie Railroad, between Buffalo and Sandusky cities, and with astonishing success. She now carries 300 tons more freight, and uses only one-half the fuel that she required with her paddle-wheels and old engines. Her cylinders are of 3 feet stroke and 26 inches bore, and her steam-pressure is 45 lbs. on the square inch.—*Scientific American.*

Loper's Improvement in Propellers.—It is frequently desirable in practice, to drive the screw-propeller at such velocity as would endanger the safety of the engines, and gearing or pitch chains are introduced in order to surmount this difficulty. The propeller Sarah, lately constructed by Captain Loper, of Philadelphia, has some arrangements for overcoming this difficulty, of a novel character: The shafts of the engine and of the propeller are placed exactly in line, a fact, by the way, which adds greatly to its convenience, and forms one of the most desirable peculiarities of this machine. To the inner extremity of the propeller-shaft is keyed a crank. The engine-shaft proper is very short, and placed some feet further forward, its after end being provided with a short universal joint. From this universal joint to the extremes of the crank extends a stout shaft, which we will term the *gyrating shaft*, on account of its peculiar motion, revolving while one end is also compelled to describe a circle. A gear-wheel is keyed on this gyrating shaft, near its after end, and a stout ring of cast-iron, with suitable gear on its interior surface, is fixed in the vessel in such position that the gear-wheel shall always mesh into and travel around within it. The proportion of the parts may be modified so that the propeller shaft shall be compelled to revolve as much faster than the engine-shaft as may be desired. The multiple in this steamer is 2¼ to 1, so that while the engine makes 100 revolutions the screw-propeller makes 225, and the apparatus is reported by the engineer as producing very little friction, noise, or vibration.

Palmer's Improvements in Propellers.—An improved screw-propeller, invented by Mr. Edward Palmer, of Southampton, England, consists of a light skeleton frame, forming two wheels, held together by cross-arms at the required distance, secured by bolts and nuts into suitable grooves, in which the curved blades—four in number—are fixed. These blades are made of plate-iron, formed to take as much purchase in the water as will have the maximum effect without choaking. One side of each blade is placed at an angle of 65°, and the other takes the water at an angle of 45°. They are capable of being removed or attached at pleasure, and to suit the power of the engine and sailing of the vessel. When not required as a propeller, this screw may be allowed to revolve by the natural force acquired by drawing through the water, with scarcely any impediment to the vessel's motion, from its lightness and the peculiar angle of the blades, as, when detached from the fast gearing, it revolves on the shaft with the slightest power. The patentee considers that the subject has as yet been but imperfectly understood, and that he has at last discovered the most perfect and effective figure and pitch of the screw-propeller; and he claims for it a ready inclination to revolve

in the slightest current of water or air, greater simplicity and power, its adaptation to attain any velocity required, high or low, and that it will propel a vessel from 50 to 100 per cent. further, in the same period, with less fuel consumed, than screws of the ordinary construction. They also work more kindly than the ordinary propellers, are not likely to receive injury at sea, and can not get foul of sunken ropes or chains from the ships in rivers.

In a discussion at the last meeting of the British Association on the effects of screw-propellers, when moved at different velocities and depths, Mr. G. Rennie stated, that from experiments which had been made under his observation, it was desirable that the screws of vessels should be of small dimensions, light, and of rapid motion, and that their effect would be increased by their being as deeply immersed as possible. He also recommended the disc screw.

Improvements in Masts.—An iron screw-steamer, of 600 tons, recently built at Glasgow, Scotland, for the African Steamship Company, has her mainmast, from step to several feet above upper deck, of a strong iron tube, into which is fitted the usual wooden mast. By this means, should the mast break, or be cut away, a new one can easily be fitted in without disturbing the cargo. This vessel has also her keel built on a plan patented some time ago, having, instead of a solid forged bar, several plates securely riveted together, thereby giving a great increase of strength at less cost.

Supporting Ships' Topmasts.—Ordinarily, the lower end of a ship's topmast is supported on what is known, in nautical parlance, as a "fid." This consists of a square bar of iron, which passes through the heel of the topmast, at right angles to the latter. The "fid" rests on the "trestle-trees," which are two stout horizontally projecting pieces, secured near the top of the lower mast. In all vessels there is more or less tendency in the "trestle-trees" to sag down out of a horizontal position, for upon them falls the entire weight of the topmasts, with all their spars, sails, and rigging. It is no easy matter to restore the topmasts to their proper position when once the "trestle-trees" have given way. Thomas Batty, of Brooklyn, N. Y., by a method recently patented, supports the topmast by providing two iron straps, which extend on an angle, from the cap of a lower mast to the ends of a bolt that passes through the heel of the topmast and answers as a "fid." The heel is also furnished with a strong iron thimble. Both straps are made in two pieces, united at their centers by nut and screw; whenever it becomes necessary to raise the heel of the topmast, it may be done in a moment by screwing up the straps.—*Scientific American.*

STORM-ANCHOR.

Mr. R. D. Guinon, of Brooklyn, N. Y., has patented a very simple and obvious improvement on, or rather attachment to, the common ship's anchor, designed to give it a better holding power in a muddy or quicksand bottom. The chief characteristic of an anchor, like that of the miser's soul, is its tenacious hold on "things of earth," and, singularly enough, its steadfast charac-

ter in this respect has made it, since the days of St. Paul, an emblem of the Christian's hope. It is from its form, weight, and area alone that it derives this character—the "mud-hook" being one of those devices which can not well be attended to and guided by hand when at work in its briny bed. The ordinary form has been found, by both theory and experiment, best adapted to penetrate and hold in every variety of bottom. The flukes are armed with broad, thin palms, but these can not with safety be extended beyond a certain degree, from the increased liability to damage in case of being jammed and twisted among rocks. In short, the present anchor is a compromise between the forms best adapted to a rocky or tough clayey bottom and that best formed to hold in a loose and treacherous earth. Mr. De Guinon's invention makes the anchor adjustable by adapting it to receive two very broad shovel-like plates of thin wrought-iron, with convenient fastenings so that they may be attached or disconnected at pleasure, forming, when in place, an immense scraper, somewhat resembling an expanded umbrella. The attachments are held in place by the aid of a collar on the shank, a strap passing round the point of the fluke, and by several bolts which pass through projecting ears on their joining edges. The place of these bolts might probably be better supplied by a clip-ring as making a far stronger connection, but this is all a matter of unimportant detail. For an anchor weighing 1,000 pounds the attachments are to be $\frac{3}{4}$ inch thick at the center, $\frac{1}{4}$ inch thick at the exterior edges, and weigh, with their fastenings, 400 pounds. Several braces, extending from suitable points in their surfaces to a point near the head of the shank, contribute very much to strengthen the structure, and an additional rope or chain is attached to an eye at the crown in order to invert and dislodge it, or discharge any material which it may bring up from the bottom. —*N. Y. Tribune.*

EXPERIMENTS WITH THE BLADES OF PADDLE-WHEELS.

A valuable paper on the above subject has recently been published in the *Journal of the Franklin Institute*, by B. F. Isherwood, Chief Engineer, U. S. N. The proper number of paddles for a wheel has been a matter of some dispute, and the question has been discussed by Mr. Ewbank, in an essay on propellers. Those who assume the position that too many paddles are generally employed, base their opinions on the assumption that "every blade, according to its thickness, forms part of a solid rim, and detracts from the propelling efficiency of the wheel," hence they insist that the number of paddles generally used on paddle-wheels should be reduced. The paper referred to throws light on this very point, and seems to settle the question. The experiments to test the question were made on the U. S. steam frigate Mississippi, during her cruise in the Mediterranean, in the years 1849, 1850, and 1851, under the direction of the Chief Engineer, Jesse E. Gray. The frigate had occasion to make a considerable number of short trips between Spezzia and Leghorn, a distance of $37\frac{1}{2}$ geographical miles. These passages were made in fine weather—light breezes and a smooth sea—and the dip of the paddles was about equal in all cases. Eight passages were made with the usual number

of paddles—21—on each wheel, and the number of revolutions taken with a counter. Every other paddle on each wheel was then removed, reducing the number to 11 (leaving two for the odd number), in their former position, and one voyage was made with the wheels in this state, and the number of revolutions was also counted. This last performance was not repeated, for the concussion of the paddles on their entrance into the water was so great as to cause an excessive vibration and shaking in every part of the vessel, the paddles struck the water, as if acting upon a solid instead of a fluid substance. "This was the more remarkable, as with 21 paddles in each wheel not the slightest vibration of the hull had ever been experienced from the action of the machinery, the Mississippi being noted for solidity and steadiness." When 21 paddles were again restored to the wheels the vibrations and shakings of the hull of the frigate ceased, and all was smooth, steady, and pleasant as before. With the 11 paddles the frigate's wheels made 3536 revolutions in the 37½ miles, while with the 21 paddles she only made 3011, that being the mean of eight passages. The amount of slip with the 11 paddles was 25·74 per cent.; with the 21 paddles 12·79 per cent. The slip, therefore, of the lesser number of paddles was twice as much as the greater number. The paddles at the periphery of the wheel—when 21 were used—were 4·338 feet apart; with the eleven 8·676 feet apart. This relationship of the paddles, and the different results produced by them are scientific data of very great importance.

WOOD-LINED BEARINGS FOR SHAFTS.

Messrs. John Penn & Sons, of England, have recently, with much success, applied a novel kind of lining to the stern-bearings of the shafts of screw-propellers. The journal is covered with a thin belt of brass, which forms the rubbing surface of the shaft. The fixed rubbing surfaces of the bearing are composed of strips or segments of *lignum vitæ*, or other hard wood. These segments of wood are fitted into dove-tail grooves in the casing, and small spaces are left between each strip to allow the water to enter and keep the rubbing surfaces cool. The segments may be made to key up when worn, by being fitted into wedge-shaped grooves. This kind of bearing seems peculiarly adapted for the situation in which the exigences of the screw-propeller have caused it to be applied.

ON THE STRENGTH OF BOILERS.

Mr. Fairbairn, in a recent lecture before the Manchester (England) Mechanics' Institute, made the following statements respecting the strength of steam-boilers. According to Mr. F., the cylindrical or spherical boiler was the most eligible and strongest form in which iron plates could resist internal pressure. The deduction for loss of strength, on account of riveted joints and the position of the plates, was about 30 per cent. for the double riveted joints, and 44 per cent. for the single ones; the strengths (calling the plates 100) being in the ratio of 100, 70, and 56. We had found that 34,000 lbs. to the

square inch was the ultimate strength of boilers having their joints crossed and soundly riveted. Flat surfaces, frequently essential, were not so objectionable with respect to strength as they appeared to be at first sight, but when properly stayed, were the strongest part of the construction. This was proved by the result of experiments made on the occasion of a recent bursting of a boiler. Two thin boxes, 22 inches square and 3 inches deep, were constructed. One corresponded in every respect to the sides of the fire-box of the exploded boiler, the stays being in squares, 5 inches asunder, and the side containing 16 squares of 25 inches area; the other contained 25 squares of 16 inches area, the stays being 4 inches asunder. One side of both boxes was a copper plate ½ inch thick, and the other side of both an iron plate ⅜th inch thick. To these the same valve, lever, and weight were attached, and the pumps of a hydraulic press applied. That, divided into squares of 25 inches area, swelled ·03-inch with the eighth experiment, at a pressure of 455 lbs. to the square inch. At the 19th experiment, with a pressure of 785 lbs. to the square inch, the sides swelled ·08-inch; and, at a pressure of 815 lbs., the box burst by the drawing of the head of one of the stays through the copper, which, from its ductility, offered less resistance to pressure in that part where the stay was inserted. The tenth experiment with the other box of 16 inch areas resulted in a swelling of ·04-inch, the pressure being 515 lbs. to the square inch. At 965 lbs., the swelling was ·08-inch; and from that period up to 1,265 lbs., the bulging was inappreciable. With the forty-seventh experiment, at a pressure of 1,625 lbs., one of the stays was drawn through the iron plate, after sustaining the pressure of upward of 1½ minutes, the swelling at 1,595 lbs. having been ·34-inch. The first series of experiments proved the superior strength of the flat surfaces of a locomotive fire-box, as compared with the top or even the cylindrical part of the boiler. The latter evinced an enormous resisting power, much greater than could be attained in any other part of the boiler, however good the construction; and they showed that the weakest part of the box was not in the copper, but the iron plates, which gave way by slipping or tearing asunder the threads or screws in part of the iron plate. According to the mathematical theory, the strength of the second plate would have been 1,273 lbs.; but it sustained 1,625 lbs., showing an excess of one fourth above that indicated by the law, and that strength decreased in a higher ratio than the increase of space between the stays. The experiments show a close analogy as respects the strength of the stays when screwed into the plates, whether of copper or iron; and riveting added nearly 14 per cent. to the strength which the simple screw afforded. These experiments were conducted at a temperature not exceeding 50° Fahrenheit. Mr. F.'s experiments on the effects of temperature on cast-iron did not indicate much loss of strength up to 600° Fahrenheit; and he concluded that the resisting stays and plates of locomotive boilers were not seriously affected by the increased temperature to which they were subjected in the regular course of working.—*London Prac. Mechanics' Jour., April*, 1855.

STEAM APPLIED TO MUSIC.

A Yankee genius has recently succeeded in harnessing steam to a musical instrument. His name is Joshua C. Stoddard, of Worcester, Mass., and the following description will give some idea of the invention:—The instrument consists of a horizontal steam-chest or cylinder, some six feet in length, and from four to six feet in diameter, which is fed with steam from the large boiler in the establishment where it is located. Upon the top of this cylinder is a series of valve-chambers, placed at equal distances from each other, into which the steam is admitted without obstruction. Each valve-chamber contains a double metallic valve, with no packing, yet it fits so closely upon its seat as to admit no steam to escape. To each of these valves is connected a very small piston-rod or stem, which passes through the chamber, and is operated upon by machinery without. Were it not for this stem, the valve would be simply a double balance-valve, and would remain stationary wherever placed, the pressure of steam being equal on all sides: but a part of one end of the valve being carried outside of the chamber, gives it the self-closing power, which is the nicest part of the whole invention, and perhaps the best patentable feature. With a slight pressure against these rods, the valve is opened; and when the pressure is removed, it closes as quick as steam can act, which is not much behind electricity. Directly over each of these valves is placed a common alarm whistle, constructed similar to those used upon locomotives, except that it admits of being raised or lowered, to flatten or sharpen the tone. These whistles are made of different sizes, so as to produce the desired tone corresponding with each note, etc. This completes the machine, with the exception of a cylinder similar to those used in a common hand-organ or music-box, containing cogs which, when properly arranged, will, when turned by hand, or otherwise, operate upon the valves in such a manner as to play any tune desired by simply changing the position of the cogs, which are intended to be movable. One of these instruments can be heard from ten to twenty-five miles on the water, and every note will be perfect and full. This invention is so completely under the control of the operator, that, were it arranged with a key-board similar to a piano, it would obey the slightest touch, and a child could play slow or quick tunes, every note of which might be heard several miles. It is the design of the inventor to place these instruments upen locomotives and steam-boats. It would appear rather novel to John Bull to hear "Yankee Doodle" from one of our ocean-steamers as she was about to enter a British port (say twenty miles), and it would remind a Yankee of his jack-knife to hear "Sweet Home" from the same vessel on its return to New York or Boston.

Remarking upon this invention, the *London Athenæum* says—"It seemed difficult to add another aggravation to the pains and penalties of a voyage;—yet here it is done, supposing Mr. Joshua C. Stoddart to prove a real person. Fancy an organ made up of steam whistles, having a twenty-mile screech—for the delectation of worn and languid folk, after some days of rough weather,

yearning for nothing so much as a cessation of the tossing, jarring, heaving motion;—and as the silence of

A sleep, for sleep itself to rest in;

—We have rarely heard of a discovery so richly calculated to excruciate all who come within its sphere.

CHAMPION'S IMPROVEMENT IN STEAM BOILERS AND FURNACES.

A patent has been recently issued to Thomas Champion of Washington, D. C., for an improved mode of feeding and keeping up continuous rapid circulation in steam-boilers, by means of a "sprinkler," and for a patent furnace and direct action exhaust steam-blower, which saves all the room, expense, and friction of a mechanical blower, and all the heat of the exhaust steam and fuel after the engine is in motion.

The invention consists in the arrangement of a tube, connecting with the feed-pump or supply-pipe, passing through the fire-box, around which it is coiled, thence onward passing into the water-space and up above the fire-box or flues, where it enters or becomes a sprinkler, which extends through the length of the boilers, above the furnace, or tubes, or flues. This sprinkler is pierced with a series of small apertures at the proper angles to sprinkle any part or the whole of the surface where the fire is acting on the opposite sides of the metal when bare of water. This tube, near its point of union with the supply-pipe, communicates with another pipe which intersects with the boiler at or near the bottom, or with a log or water-space. It is also furnished near its point of junction with the boiler-pipe with a valve hinged above the junction. While the pump is feeding, or the supply passing into the boiler, this valve will raise with the pressure under it, closing the boiler-pipe, and the feed-water will pass on through the coils, grate, tube, and sprinkler, entering the boiler intensely heated; but should the pump fail to supply, the steam and hydrostatic pressure in the boiler and the first pipe, will then open the valve and admit the water from the boiler into the first pipe, and the intense heat to which its coils are subjected in passing through the furnace, cause the hot water and vapors to pass upward with continuous rapidity through the sprinkler, jetting and spraying the plates, whether the pump is feeding or not, so long as any water remains in the boilers: thus all the water may be evaporated, the steam exhausted, and the engine stopped, yet no explosion takes place, nor even the boiler be injured, provided the fire be extinguished as soon as the engine shows signs of stopping. With one third the usual quantity of water in the boilers, and the continuous showering of the plates, renders the evaporation three times more effective, and the mode of feeding cold water round through the coils in contact or nearly so with the fire-box plates, admirably prevents their destruction, and saves much heat and loss in replacing burned grate bars.

For single or double flue cylinder boilers is also placed a drying-pipe in the rear end of the fire-space, into which the exhaust steam from the engine is conveyed; the drying-pipe has exit pipes conveying the exhaust steam into

the center of each flue of the boiler, to force the return of the unconsumed heat, smoke, and gas, from underneath the boilers through the flues and down the passage by the direct action of the exhaust steam, which exhaust commingles with the products of combustion, becoming part and parcel, thereof, aiding in the intensity of heat, round and round the continuous current, which receives small supplies of fresh air in jets from a pipe arranged for this purpose between each puff of the exhaust, which gives life to the fire, with a closed chimney, furnace, and ash-pit. An additional pipe is fitted to one end or middle of the drying-pipe, with a valve in it for the escape of a small portion of the exhaust steam into the atmosphere, should it exert too much force on the fire when running at the greatest speed. Conduits are provided, leading the products of combustion from the flues up the stack while a damper is open and the fire is kindling and steam is raising, but when steam is up, the damper and ash-pit closed, and the engine running, then the exhaust forces all down the stack beneath the grate, and up through the fire round and round, saving and burning all the heat, smoke, gas, and exhaust steam. And the size of new boilers to which these improvements are to be attached, may be reduced, at least one third, as the whole boiler may be enveloped in the furnace, except a small dome or drum to take dry steam from. The additional expense for attaching these improvements to boilers and furnaces now in use will not exceed, in general, five dollars to the horse power, and in the construction of new engines and boilers, the cost will actually be less than the ordinary boilers and furnaces now in use.

Ericsson's Hot-Air Engine.—During the past year reports have been from time to time circulated that the caloric engine, devised by Mr. Ericsson, had proved a complete failure, and that the principle on which it was constructed had been finally abandoned by Captain Ericsson, who had substituted steam engines in the ship with which his experiments were made. These reports awakened profound regret, not only in the minds of those who were aware from personal knowledge of the great abilities, unwearied labor, and large sums of money which had been devoted to this experiment, but also on the part of the public, which had become deeply interested in its success. Nor was it easy to understand, in the face of results known because *seen* to have been attained, how the *principle* of the caloric engine could have proved a failure: for in the trip of the Ericsson to Washington a propelling power was certainly obtained at less expense for fuel, and with a greater saving of room, than had ever before been achieved.

From the following letter, communicated to the New York *Times* by Captain Ericsson, it will be seen that he has *not* abandoned the caloric engine—that while mechanical difficulties have prevented the satisfactory application of the principle, his faith in the principle itself remains unshaken, and that he is still engaged, with unwearied assiduity and with unflinching courage, in the prosecution of experiments for its perfection. He says: "The assertions of my opponents that the caloric engine has failed and been abandoned, and that a 'new steam engine' has been put into the Ericsson, are all wholly unfounded. Every trial made has proved the soundness of the *principle* of the caloric engine, an extraordinary saving of fuel being in every instance well established.

I have deemed it prudent, however, not to publish certain facts conclusive as to ultimate success, because it would have encouraged many to help me to 'improve,' and deprive me, if possible, of the fruits of much labor and expense. The first engine of the caloric ship was removed, notwithstanding its economy, because it proved too cumbrous for the amount of *available* power it exerted—in other words, because the differential force of the working and supply piston did not prove in practice to realize what calculation promised—losses by leaks, friction, etc., being much greater than reasoning could anticipate. The second engine was applied to remedy this deficiency of power, by employing *compressed* air—but it was found that the joints of the pipes of the heaters could not be made sufficiently tight to carry more than one third of the intended requisite pressure. Accordingly, this modified engine proved inadequate to give a speed of more than seven miles an hour to the ship. Apart from the imperfections connected with the leaks alluded to, the machine worked to the admiration of all who witnessed its operations. But although *air* thus escaped through the joints, steam, it was found, could easily be retained in the heater pipes, and was, therefore, employed in a surcharged state, in place of air. It was under the agency of surcharged or overheated steam that the machinery operated on the day of the sad accident of sinking the ship. The sudden immersion and cooling of the furnace pipes, etc., unfortunately destroyed a vital part of the contrivance, and after fruitless attempts to repair and patch, no alternative was left but to apply ordinary boilers. The *engines*, however, are now without alteration; the same as when compressed air was employed. The statement that 'new steam engines,' planned and constructed for the purpose, have been put into the ship, is pure fiction. I promised the owners of the ship, on proposing to remove the original caloric engine, to build the second one in such a manner that if we failed in using air, steam might be resorted to by replacing the air heaters by steam boilers.

"The stories relative to the 'burning of the bottoms' of the original caloric engine I have deemed it unnecessary to notice, as many practical means, obviously, might have been adopted to overcome the difficulty. Numerous have been the suggestions I have received from correspondents in various countries, all proving that I am not alone in thinking that the 'incurable burning of the bottoms' was, after all, no serious matter. The positive assertion, that I have altogether abandoned the caloric engine, is a base calumny. The subject has been by me unceasingly prosecuted. Experiment has succeeded experiment, and continued exertions have been made to devise and perfect the useful mechanical expedients for rendering the incontrovertible physical laws involved in the principle of this machine subservient in producing a cheap and harmless motor. How far I have succeeded in the final practical solution of the great problem will soon become known, as I am now engaged in building a test engine of considerable magnitude.

"Let me add that should some unexpected difficulty prevent a full realization of the capabilities of the new system, when the said test-engine shall be put in operation, such an event will by no means stop the prosecution of the matter; nor will any mechanical difficulty whatever cause the writer ever to abandon a plan so eminently based on physical truth, and fraught with such

vast beneficial results when perfected. It is much to be regretted that so important a matter should be in any manner retarded by the obtrusive interference of persons who do not possess knowledge enough to understand that our present motor, the steam-engine, working as it does within very limited range of temperature, and constantly wasting the caloric, never can be made an economical medium of transferring the force of caloric for motive purposes. Happily, while those who only pretend to science thus assail the good cause, the highest authorities support it. Regnault—the greatest living authority in relation to caloric—in a memoir to the French Academy, after discussing the relations of force produced, and range of temperature, says: 'But, as in the Ericsson system, the heat which the air gives out is given up to bodies, from which the entering air takes it again and brings it back to the machine, we see that, theoretically, *all the heat expended is utilized* for mechanical work, while in the best steam-engine the heat *utilized in mechanical* work is not the one-twentieth part of the *heat expended.*' Endorsed by such authority, and fortified by such opinions, the writer disregards assailants, and will continue to labor at the perfection of the caloric engine until the end is achieved."

Since the abandonment of the original features of the *Ericsson Steamer*, the vessel has been used with ordinary engines, still retaining the improved boilers and condensers introduced by Mr. Ericsson. With these improvements some very extraordinary results have been attained to. The results of experiments made under the direction of Mr. Charles H. Haswell, showed that 9.96 pounds of water were evaporated with the consumption of each pound of anthracite coal consumed, "and notwithstanding this unprecedented attainment in a marine engine, it could have been very materially increased with better firing of the furnaces."

By the use of Ericsson's improved condensers, a larger amount of fresh water for re-cooperation was obtained, under the same circumstances, than with any former condensing apparatus.

IMPROVEMENTS IN STEAM-ENGINES AND BOILERS.

Storms's Cloud-Engine.—Mr. W. M. Storms, of New York, professes to have made new discoveries or applications of natural laws, which are to result in increasing the efficiency of a given amount of fuel in the steam-engine. The company formed to carry out and apply the intentions of Mr. Storms, have subjected the theory to the test of several expensive experiments, and one engine of respectable size, constructed on this plan, has been for some months in actual daily use, driving the fans and other machinery of a small foundery and machine-shop. The plan consists in mixing cold air with ordinary steam. It is assumed that in addition to the familiar forms of ice, water, and steam, the aqueous element is capable of existing in a state of vesicular vapor, or opaque steam, a form more familiar to the eye than the transparent steam, but never before suspected of possessing any mechanical power above or even equal to that of the latter.

If a glass bull's-eye be introduced in the top or side of an ordinary steam-boiler, the steam within is found to be perfectly transparent and invisible.

But on turning a cock the escaping steam is found to be white and cloud-like. This is due to the cooling effect of the air, which mixes with and apparently condenses it. Mr. Storms's experiments lead him to the conclusion that the volume of the whole is increased by the combination, and this to a very considerable degree, as high, under favorable circumstances, as 75 per cent., and consequently affording a corresponding increase of efficiency in an engine. If common air be compressed and introduced at an ordinary temperature into a vessel containing steam at the same pressure, the following effects may be anticipated: On the one hand, a portion of the steam will be condensed and changed to water, which will diminish the pressure; but on the other hand, the air will be heated and expanded; and these two effects may be supposed very nearly, if not exactly, to balance each other. But the experiments alluded to indicate a very decided increase of volume, provided there is a sufficient difference of temperature. If pure transparent steam be mingled with air previously heated to the same degree, none of this expansion is experienced, and it becomes a question how to compress air in a pump and convey it in a cold state into a heated cylinder.

Mr. Storms avoids the solution of this difficult problem by allowing the air to mix thoroughly with the steam at any temperature it may chance to have, cooling it afterward by expansion. In other words, he mixes hot or warm air with the steam in the steam-chest, and does not expect the mixture to assume the cloud form until it commences to expand in the cylinder. The act of expanding cools both steam and air, but in very different proportions. Pure steam, of a high pressure (say 60 pounds), has a temperature of about 310° F., and if cut off at half-stroke, so as to double its volume by expansion, cools down to only about 270, while air at the same temperature, if expanded to the same extent, cools down to about the freezing point. Thus the combined fluids may readily be compelled, by expansion, to assume the form of cloud or vesicular vapor, if the presence of air at a different temperature be the only condition necessary. To accomplish this object in an ordinary horizontal engine, Mr. Storms has, in the instance above referred to, placed a double-acting air-pump near the cylinder, and allows it to discharge into the steam-chest, just above the valve. As the first portion of the stroke of the pump is spent in simply compressing its contents, it is so timed that it will begin to deliver with the commencement of the stroke of the piston. The pump is enveloped in a jacket of cold water to keep it cool, and the air probably enters the steam-chest at a temperature of from 180° to 250°

A series of experiments have been lately tried at the Novelty Works on a tolerably large scale. The engine was run first with steam alone, and then with the cloud combination, the resistance being constant in all cases. The revolutions produced per lb. of coal were as follows: steam 107, cloud 190; showing a great advantage by the use of the cloud vapor.

Mackenzie's Cut-off.—A device for regulating the motion of steam engines without the aid of a Governor, has been invented and patented by Mr. P. W. Mackenzie, of Jersey City, N. J. The arrangement is described by the New York *Tribune* as follows: The valve is designed to close the steam-pipe at or near its entrance to the steam-chest. It is capable of "cutting off" at any

point varying from nothing to about half-stroke. The valve is lifted by the machinery in proper time to commence the stroke, and is held suspended by a coiled spring until the rush of steam is sufficient of itself to shut it. It is easy to see, from the nature of the crank motion, that the piston, at the commencement of the stroke, moves very slowly, and as the crank in its onward motion successively assumes positions in which the piston moves faster, the rush of steam through the opening is proportionally increased. The valve may be described as a thin ring, which, by the aid of a circular fixture held within it a little above its seat, completely stops the passage when down, but allows the steam to flow under its lower edge whenever it is lifted. At whatever point in the stroke the motion of the piston becomes sufficiently rapid to produce a strong rush, or a slight "wiredrawing" of the steam in its passage through the orifice at that point, the action upon the upper edge of this ring will overcome the resistance of the spring, and the valve will be "sucked" down and closed tight. In practice the valve consists of *two* rings, one placed concentrically within the other; a fixed ring is fitted between them (supported by suitable projections from the seat below), and the opening for the passage of steam is consequently an annular rather than a circular one. Several devices are connected with this to render its action more perfect and quiet, one of which is a piston attached to the valve-stem, which piston works loosely in a small cylinder above, to prevent it from rising too rapidly or too far. We describe this as a late invention and a decided novelty, although there appears to exist an inherent and radical defect which prevents its regulating perfectly, although it may possibly work as nearly so, as the governor balls ordinarily do. The fault is that as the rush of steam is always proportional to the motion of the piston, the valve always shuts when the piston has attained a certain velocity; when, therefore, by reason of diminished work or an increase of boiler pressure, the valve is dropped at an earlier point in the stroke, it is proved that the piston must have acquired a high velocity too early in the stroke, and that consequently its mean velocity must be very considerably increased, and the engine makes more revolutions in a given time. It is an evil of the same kind as attends the working of a conical pendulum or ordinary governor, but the economy of regulating by the "cut-off" rather than by a throttle-valve is sufficiently great to invite attention to this method, which is also much recommended by its simplicity and cheapness.

Clark's Patent Boiler Feeder and Indicator.—This invention consists of a short horizontal metallic tube of say 3 feet in length and 2 inches in diameter, suitably attached to the outside of the boiler, or to a wall near by. The height at which the tube is placed should be the same as that at which it is desired to maintain the water-level in the boiler. One end of the tube communicates with the upper or steam part of the boiler, the other end with the water part; when the water in the boiler is at the proper level the tube will be one half filled with water and one half with steam. A small cold water pipe passes lengthwise through the tube; one end of this water pipe is plugged tight, the other end is furnished with a metallic cup covered with rubber, forming a diaphragm. On this diaphragm rests a plunger rod attached to a lever, the latter connected with the pump throttle. When the

water in the boiler falls below the level of the tube, the latter will become wholly filled with steam and heat up the water pipe, forming steam in it also; the pressure thus produced in the water pipe will extend the diaphragm, raise the throttle lever and permit the pump to inject water into the boiler; when the water level is restored the tube again fills, in part with water, the pressure on the diaphragm ceases, and the pump throttle shuts.

Improvement in Governors for Steam Engines.—Ball governors are the kind now almost exclusively used on all stationary steam engines; they are not adapted to marine purposes, because they always require to stand plumb. In all cases they are comparatively sluggish in their operations; where the driver is required to run fast the old-fashioned governor must be geared to a slow speed, for if it goes beyond a certain velocity it will not operate. And when thus geared, the machinery at times almost has a chance to run away before the governor affects the throttle valve. An ingenious improvement to obviate these difficulties has recently been made by Messrs. J. & E. Arthur, of New Brunswick, N. J. Instead of swinging arms and balls, they use slender elastic springs or ribs, which, when applied to the governor spindle, look—to use a homely comparison—like the frame of an oyster-balloon stripped of its covering. These ribs are attached at one of their ends to a collar fixed fast on the spindle. The other ends terminate on a sliding collar which connects with the throttle. When rapid motion is communicated to the spindle the elasticity of the ribs is overcome by centrifugal force, and they bulge out in the center; in other words, their poles flatten, just as the earth does in revolving; the result is that the movable collar slides up or down on the spindle, in conformity with any variation in the speed, and operates the throttle in accordance. It will be evident to any mechanic that this governor will be more sensitive than the ordinary kind, since it may be geared to run at a higher speed than the engine, and thus caused to move the throttle, in case the velocity changes, before the machinery could make even a quarter of a revolution. As a marine governor this improvement seems to be also well suited, since the position in which it is placed, makes no difference with its operation. It is much cheaper in its construction than the ordinary governors.—*Scientific American.*

Ignition Gas Engine.—At the recent fair of the American Institute a large engine, called the "Ignition Gas Engine," was exhibited. The principle on which this engine acts is that of first filling the cylinder to a certain extent with explosive gas, next igniting the gas by an electric spark or otherwise, and allowing the piston to travel to the end of the stroke by the impulse thus obtained. The gas employed may be any combustible one mingled with air. Fairbairn and others, in a report to the British parliament on coal-mine explosions, stated that one part coal gas, with fifteen of common air, would form a mixture it were possible to explode; but a pamphlet explanatory of this engine informs us that one part in nine is found most economical in practice—which is probably the case. The vapor of spirits of turpentine, or its relatives, naphtha, camphene, etc., may be used as well as coal gas for this purpose: and a very ingenious, or rather a complex arrangement of pieces, is provided for attaching the igniter. It appears that hardened cast-iron is thought to be

the most durable material for an igniter, and that a continual circulation of water through the piston-rod and around the cylinder is considered the best method of disposing of the surplus heat, which would otherwise destroy first the lubricating material, and next the metal itself.

Pendulous Reciprocating Steam Engine.—A novel and cheap engine has recently been invented with the above title. It is an "eccentric revolving on its own diameter" in a "cylinder," or steam-chamber, suspended as a pendulum, the shaft on which the eccentric piston is keyed being the main or driving shaft, and makes upward of 100 revolutions per minute in a 30-horse engine. The principle of this is similar to the ordinary engine, but it works with much less friction; a 30-horse high-pressure will work with one pound of steam. "An eccentric revolving on its own diameter" contains the two motions of the ordinary engine, viz., rectilinear and revolving, though so amalgamated as to be hardly distinguishable. This engine, from the small space it occupies, and the speed that can be obtained direct, is especially adapted for screw propulsion.

Pattison's Improved Oscillating Engine.—The principle peculiarity of this engine is, that it does not, as in ordinary oscillators, admit steam at the trunnions, but takes it in through an arched pipe surmounting and secured to the cylinder. As the cylinder oscillates on its trunnions, it simultaneously brings the induction and exhaust ports into communication with the steam ports in the wings or flanges of the saddle which fits over the arched steam-pipe. By thus receiving the steam, friction is saved, the motion is left freer, and there is also, of course, a diminution of wear and tear. Its arrangements, also, render it more promptly reversible than any other engine which we have yet seen. The same lever and eccentric rod, by which the motion is reversed affects the cut-off valve. The cut-off valve, besides serving to stop, to reverse, and to cut off the steam, answers the purpose of an exhaust pipe as well. The cylinder lies in a horizontal position; and the saddle, which fits over the arched pipe to which we have referred, is so constructed as to rest on adjustable screws, allowing the saddle to accommodate itself to the motion of the cylinder, etc., etc. The engine is alike adaptable and equally efficient for locomotive, standing, or marine purposes.

Improved Locomotive Boiler.—A new form of boiler has recently been tried in its application to locomotives, in England, with great economy in fuel, and time—it is said—in getting up steam. The improvement consists in piercing the sides and top of the fire-box, and the crown plate of the boiler flue, with a number of holes about three inches diameter, into each of which, projecting into the water space, is riveted a malleable cast-iron cup, from four to six inches deep, those on the sides being cylindrical, while those on the crown plate are spherical. These cups are, of course, covered in every direction by the water in the boiler, and the inside being exposed to the heat of the fire and concentrating the temperature, present so much additional heating surface, that the boiler is enabled to get up steam in a vast deal less time, with a diminished quantity of fuel.

At the Boston locomotive works, a twenty-two ton passenger locomotive has been recently constructed on an entirely novel principle. For the gener-

ation of steam in the engine, coils of pipes are placed one upon the top of the other, which contain the water, and upon which pipes the fire is directly brought. It is intended to burn coal, and it is thought steam can be made in ten or twelve minutes from the time of kindling the fire. Another novelty is that the engineer is placed ahead of the smoke pipe. The fireman is to be placed behind the boiler.

IMPROVEMENTS IN BLAST PIPES.

Mr. H. Booth, of the Liverpool and Manchester railway, was probably the first who utilized the impetus of the steam escaping from the cylinders by allowing it to increase the draft of the fire. A locomotive must have great power with a moderate weight, and the boiler being small, the fire must burn very fiercely or the engine will be short of steam. By turning the exhaust steam into the chimney, and pointing it upward, every jet of vapor expelled impels the sluggish smoke more rapidly upward, and draws a fresh supply of air through the burning fuel to supply its place.

The nozzle through which the steam escapes in this manner is termed a blast-pipe, and in proportion as the orifice is contracted the steam escapes with greater velocity, and produces a greater draft, but at the same time retards the motion of the piston by creating a back pressure thereon. The propellers on the lakes have very large exhaust-pipes, contracted very slightly, if at all, at their extremities in the chimneys, while the high-pressure steamers on our western rivers ignore altogether the promoting of a draft by this measure, considering that the steam rusts and destroys the chimneys more than it helps the fire. In locomotives, however, the blast nozzle is generally contracted to an orifice of between two and three inches diameter, and the vigorous coughs of the smoking monsters in starting with a heavy train, when the steam is allowed to follow at full pressure, attest the spunk with which the imprisoned vapor escapes through its narrow gateway. A most complete device for increasing the efficiency of the blast without materially contracting the area of its escape has been invented by Mr. William E. Cooper at the Dunkirk terminus of the Erie railroad. Mr. C. leads the exhaust-pipes from both engines between two concentric rings of sheet metal placed in the smoke-box, and by their aid spreads out the current of steam into a tube-like form, which acts by the friction of both its internal and external surface. By this means a sufficient draft may possibly be obtained without contracting the area, or by contracting it to the usual amount a much increased draft may be obtained.—*New York Tribune.*

STATISTICS AND MANAGEMENT OF THE NEW YORK AND ERIE RAILROAD.

We copy from the New York *Tribune* the following detailed account of the statistics and management of the New York and Erie Railroad, as showing not only the extent of American railroad enterprise, but also the wonderfully systematic operations of one of the longest single roads, and one of the largest

corporations in the world. This road is also doing a greater amount of business in freight than any other road of the same length ever constructed. "We were especially invited," says the *Tribune*, "to present this statement from learning this fact, that the officials on this extended road are able to tell, at every moment of every day, where every locomotive and every car was upon the road, and whether they were in service, or in ordinary, or at the repair-shops, or whether if moving, who was moving them, and which way, and whether they were loaded or empty. It did seem to us a sort of knowledge that must require a little spiritual agency, but we found it only required the agency of rules and discipline, and perfect order of business, aided by the telegraph. There are near 3,000 cars, and over 200 locomotives now in use on the road: These are all regularly numbered, and by those numbers entered upon a book on the left side of a page, which is headed with the dates, one, two, three, four, etc., of all the days in a month. Then all the stations are numbered and known by the numbers. Now, suppose we want to find or follow the progress of car No. 2,167, from station No. 1, which is Piermont, through to Dunkirk, which is No. 74. Suppose the agent at Dunkirk writes to inquire why certain freight has not been forwarded. The agent here replies it has been: it was loaded, Sept. 7, at Piermont, in car No. 2,167. Then where is that car? A glance at the book shows. Opposite No. 2,167, under date Sept. 7, we find the figure 1. That shows that this particular car was there that day. It must have left in the evening, because we find no other number under that date; but on the 8th we find by the numbers entered that it was at half a dozen other stations. We follow up the numbers till we find, on the 9th, it was at No. 34, which stands for Susquehanna, and there stands car No. 2,167. What is it doing there? We refer to telegraph reports of that day, and find that John Smith, conductor of train No. —, 'arrived at this station this morning, and the examiner found the axle of forward trucks of car No. 2,167 defective and very dangerous. Switched out for repair.'

"That is all right, but why has it not been switched in again?

"Click, click, click, goes the telegraph, and back comes the answer: 'Car No. 2,167 repaired same day, and Peter Stokes ordered to put it in night train west. Reports that he understood east, and sent it that way an hour since.' Click, click, click, again, and car No. 2,167 goes about face at the next station, and Peter Stokes is ordered up to the superintendent's office, and then, on satisfactory proof that the order was correctly given and wrongfully executed, he is discharged. So every car can be closely tracked, and every act of carelessness ascertained and corrected on the instant. Every car is not separately reported at each station, but every train is; and in another book there is a record of every train started, with every car and contents in the train; and what locomotive, and who is the conductor and engineer; and how much each car weighs, and how much weight it is loaded with; and how fast it runs, and how much it costs per ton per mile to draw the load; and if any cars are added on the road it is known when and where; and if any are left, when, and where, and why. If any one leaves loaded cars where he should not, he will be likely to be left off of the pay-roll, and if he don't take on and haul cars when ordered, he will be hauled up at the next station

and ordered to give his train in charge of another man. Disobedience of orders is not tolerated on this road, and upon that depends its safety.

"But the reader, we doubt not, before proceeding further, would like to glance at the history of this road.

"In 1825 the Legislature directed a survey of a State Road from Lake Erie to the Hudson River, through the southern tier of counties, but nothing was done but talk, until April, 1832, when the New York and Erie Railroad Company was chartered. A survey was made, and this Company organized in 1833. In 1834 another survey was made, and in 1835 the Company was reorganized, with James G. King President, and over two millions of stock subscribed, and contracts made for the most difficult part along the Delaware river. In making surveys it was ascertained that the road could not be built without crossing the Pennsylvania line, except at an expense beyond the means of the Company. Notwithstanding the very great benefit it would be to that part of the State touched by the road, Pennsylvania refused the application, except upon condition that the Company should *pay* the State the enormous rent of $10,000 a year for the privilege of crossing her line and cutting through some rocky mountains. Necessity compelled the Company to submit to these conditions, almost as hard as the rocks they had to cut through where they traverse that State along the jagged points of rocks that jut into the Delaware river. Almost equally hard was the restriction placed upon the Company by the Legislature of New York, by which they were confined to the State at the eastern terminus of the road, instead of passing into New Jersey and reaching this city by the shortest route, cheapest grade, and altogether most natural way, and, as has subsequently been proved, the only way in which the Company could hope to maintain a chance for a proper share in the passenger business. After much trouble it was finally located from Piermont, 24 miles above the city, to Dunkirk, 40 miles west of Buffalo.

"The first iron was purchased in 1840, but in 1842 the Company were so embarrassed that they could not go on, and for three years the prospect of completing the road was very dark. In 1845 only 53 miles had been completed, but on the 14th of May, 1851, there was a continuous line of rails from Piermont to Dunkirk. The length of rails between these two points is 445 miles, and upon 166 miles of the distance there is a double track—that is from Piermont to Clarkstown, 9 miles; from Suffern to Port Jervis, 56 miles; from Deposit to the junction of Canandaigua and Elmira Rail-road, one mile west of Elmira, 101 miles. This, including switches, turn-outs, and tracks at stations for storage-room for empty cars, makes a distance equivalent to a single track railway on this main line of 707 miles. In addition to this, the Company own, by perpetual lease, the line from Jersey City to Suffern, where it joins the main line, 18 miles from Piermont. This line is 32 miles long, of which 16 miles are double track. The Company also own a branch to Newburg, 18 miles long. There are also several other roads, though owned by other companies, that are properly branches of the Erie Road, as they are in a measure dependent upon it, as well as serving as feeders. These roads, as well as the Lake Shore Road from Buffalo to Erie and westward, all contribute to the business of the Erie Road, and hence its magnitude. The length of

all the tracks of main road and branches owned by the Company, not including those of other companies, would make a single track road 755 miles long. It is not easy to state the cost of the road track separate from the rolling stock and other property of the road, but there are single miles that cost to grade and get ready for the iron no less than $170,000 per mile; and there is one bridge, that over the Starucca Creek, near the village of Susquehanna, which is built upon 17 stone arches, the highest of which is 100 feet, and the entire length of the bridge is 1,600 feet, and the cost $320,000. In the same vicinity there is another bridge across a mountain gorge, only 276 feet in length, but 180 feet in height. The most expensive part of the grading for any considerable distance was that along the Delaware river where the bed of the road is sometimes constructed upon a ledge formed by blasting off a portion of the almost perpendicular mountain side, or cutting away the hard rocky points that project into the river to such an extent that it seems almost incredible to those who know the character of the country and the extent of the obstructions, that a roadway could be formed by any practical amount of expenditure. The distance from Jersey City to Dunkirk is 459 miles, and this is run by the morning and evening express trains in 16 hours. Besides the express trains there is a through train carrying the mail, leaving at 8¼ A. M., and stopping over night at Owego, and an emigrant train that leaves every evening. Besides these there are accommodation trains, way trains, milk trains, stock trains, and freight trains enough to confuse one to think of, yet all work with regularity.

To enable our readers to form some opinion of the magnitude of railroad operations, we have been at some pains to ascertain the number of engines and cars on the Erie road, and have coupled them all in one train, in imagination, which we think will surprise every one in its extent. The following is the number now in use, as near as it can be ascertained, as slight changes are made every day. The power consists of the almost incredible number of 203 locomotives. About one third of these are employed to move passenger trains.

First-class passenger cars,	102
Second-class passenger cars,	28
Baggage, mail, and express,	43
Box freight-cars,	1,222
Platform freight-cars,	1,180
Cattle freight-cars,	290
Trucks for lumber, etc.,	100
Total number of locomotives and cars of all kinds,	3,168

"If these were coupled together in one train, it would reach a distance of 21 miles, and would be able to seat 7,800 passengers, and also to carry a load of freight that may be imagined to contain the following articles, if the cars were all loaded equally:—

Barrels of flour,	33,483
Bushels of wheat,	93,186
Bushels of oats and corn,	129,735
Gallons of milk,	558,000
Number of beef cattle (averaging 15 head to a car),	4,185

Number of sheep (averaging 175 head to a car),........	48,825
Number of hogs (175 to a car),........................	48,825
Tons of merchandise (8 tons to a car),................	2,232
Tons of coal (10 tons to a car),......................	2,790
Lumber (25 cwt. per 1 M.),......................feet.	2,232,000

"Or, in case of emergency, this road, with this power, would be able to transport from Lake Erie to this city in one day 150,000 soldiers. And this is the only one out of eight roads centering in this city that could be used for the same purpose. Verily our railroads, in place of fortifications, are stronger than all Sebastopol.

"The cost of the equipment of this and other roads may be calculated from the following statement:—

"The cost of a first-class locomotive which weighs thirty tons, and is capable of drawing over the whole road in sixteen hours a train of eighteen cars with 1,100 passengers, is about $12,000. The cost of a first-class freight locomotive, capable of trucking 600 tons of dead weight in freight cars, is about the same price, though it weighs some two tons heavier. The cost of the smallest locomotives in use is $6,000 to $8,000. A first-class passenger car, with all the modern improvements of ventilation and warming, will cost $3,000. A second-rate car, $2,500, and a second-class passenger car, $1,800. Freight cars will average about $600 each. The iron rails on this road, are 56 lbs. to 74 lbs. per yard, and, at present prices, would cost $4 per yard, or $7,000 per mile for a single track of the lightest rail.

"But after all, the most curious part of the whole is the number of men required to keep the machinery in operation. We think we shall astonish many persons by telling them that the Erie Rail-road Company have now upon their pay rolls not less than FIVE THOUSAND employees of all grades, to wit: in the various offices of president, secretary, superintendent, auditor, treasurer, freight-agent, and in the printing-office in the building of the Company, there are 60 persons employed.

"There are 12 division superintendents and assistants in the offices at Jersey City, Port Jervis, Owego, and Dunkirk. There are in the machine shops at Piermont, 225; at Susquehannah, 200; at Dunkirk, 115; and 150 car repairers. There are 44 passenger train conductors, and, much to their credit and respectable appearance, all in a neat uniform. There are 80 freight conductors; 450 engineers and firemen; and 400 brakemen and baggage men. There are 90 ticket sellers and station agents, and 60 telegraph agents. There are about 1,000 laborers and switchmen, and some 800 track repairers, averaging about one and a half man to the mile, constantly engaged to keep the road in order. The pay roll of this army is not less than $125,000 a month, or $1,500,000 a year.

"We spoke of the printing-office. The business of this road requires a constant force of four compositors, and the use of half-a-dozen presses, great and small; one of which is constantly at work printing tickets, which are never used but once, and are then returned to the auditor's office as checks upon the parties who sold them. There is one large room in the building devoted to the storage of printed blank forms, which are very numerous, in use by the

Company. These are necessary where every thing is conducted according to nature's first law—order.

"Of the advantage of telegraphs on rail-roads, we have already given our opinion; but its operation and daily use will be better understood by copying a few of the hourly dispatches sent to the office of the General Superintendent. Here is one:—

"'TELEGRAPH OFFICE, New York, Sept. 28, 1855—1:14 P. M.

"'To D. C. MCCALLUM, General Superintendent—SIR: The following are the latest reports of trains received at this office: Mail west—New York express at Canisteo, on time; Rochester accommodation at Oswego, 10' late; night express west at Dunkirk, on time; mail at Alford, on time; New York express at Little Valley, 15' late—detained at Tremont by night express west and mail express east; mail east at Little Valley, 10' late; immigrant at Great Bend, 12' late; New York express at Addison, on time; Rochester accommodation at Campville, 28' late—detained taking on freight.'

Another report that came in while we were present one day, reported that the night express east was detained twelve minutes at Hale's Eddy by freight No. 2. The question was immediately asked, What was the difficulty with frieght No. 2 this morning, detaining night express east twelve minutes at Hale's Eddy. Answer—No. 2, with 35 loaded cars, left Deposit, intending to switch for night express east at Hale's Eddy, but in approaching the switch the engine was crowded by and was not able to back up; conductor, fearing that he would be in night express train time before reaching Dickinson's switch, left a flagman at Hale's Eddy to give express train notice; night express in running slow lost the twelve minutes, but passed freight No. 2 all right at Dickinson's. Then the telegraph ordered the conductor of freight train No. 2 to explain why he allowed his train to run so fast as to be crowded by the proper turn-out, contrary to positive orders. If he failed to give satisfactory reasons at once, he would be suspended till he could do so.

"Such is the discipline on this road—such it should be on every road—and then travelers would feel a degree of safety that they do not now enjoy. But with such an immense quantity of rolling stock, and such a length of road, what would be the condition of things without discipline, order, and the telegraph."

TABULAR STATEMENT OF THE DURATION OF IRON RAIL-ROAD BARS.

The duration of the iron rails of our great railroads is a subject of vast importance to all interested in the maintenance and extension of rail-way communication. In all estimates for new roads for thinly-settled districts, the cost of the iron rails figures as the most prominent item; and even in the thinly-settled states of Europe, where the metal is obtained at a comparatively cheap rate, the cost of the rails forms no inconsiderable portion of the whole expense of construction. On the first introduction of railroads, it was confidently asserted by their promoters, that the iron rails would last for an indefinite period. A few months working, however, demonstrated that although manufactured from the best metal, iron railway bars were subject to lamination and disintegration from the repeated rolling of heavy loads. Their dura-

tion, in numerous cases, did not exceed two or three years, and in no instance of a rail-road having a heavy traffic, have the rails remained sound and in working condition for more than 14 years. On some of the earliest constructed lines in England, the rails have been changed twice, and even three times, within twenty years. Opportunities have, therefore, presented themselves to the engineers of such lines, of ascertaining the actual traffic which iron rails are capable of withstanding under different circumstances.

The following table prepared by William Truran, Esq., and published in the *Canadian Journal of Science*, shows the durability of different varieties of railroad iron in thirteen carefully noted instances:—

Number of case or example.	Weight of rail, in pounds, per yard.	Depth of rail in inches.	Bearing surface, presented by sleepers for each lineal foot of track, in superficial feet.	Greatest weight rolling on four wheels, in tons.	Greatest weight on a foot lineal of track, in tons.	Velocity of trains in miles per hour.	Motive power employed.	Gross traffic over a single track of rails before renewal, in tons.	Weight of rails per mile for a single track, in tons.	Cost of rails per mile, estimated at 50 dollars per ton.	Number of tons carried over one mile of road for each dollar's worth of iron consumed.
1	56	2.5	.75	16	2.7	16	Locomotive	1,822,800	88	4400	414
2	63	3.75	2.25	16	2.7	16	Locomotive	12,000,000	99	4950	2424
3	56	2.5	1.75	7	1.2	12	Gravity	4,043,500	88	4400	919
4	56	2.5	1.1	7	1.2	3	Horses	9,800,000	88	4400	2227
5	90	3.4	1.7	14	2	8	Stationary	8,000,000	142	7100	1126
6	55	5.	1.1	8.5	2.2	3	Horses	1,628,640	86	4300	378
7	56	2.37	2.1	4.8	1.5	6	Stationary	7,840,000	88	4400	1781
8	75	2.5	1.5	11	2.4	12	Locomotive	5,500,000	117	5850	940
9	40	3.87	2.5	5.9	1.3	4	Horses	15,000,000	63	3150	4126
10	50	4.5	2.5	16	2.8	30	Locomotive	10,000,000	78	3900	2564
11	72	5.	2.7	16	2.8	30	Locomotive	41,000,000	113	5650	7256
12	72	5.	2.7	16	2.8	30	Locomotive	22,400,000	113	5650	3964
13	46	4.25	2.	10	2.1	10	Locomotive	1,318,000	72	3600	363

EXPERIMENTS IN STOPPING RAILWAY TRAINS.

Some experiments were recently made on the Brighton and South Eastern Rail-way, England, by Capt. Tyler, for the purpose of ascertaining in how short a period and distance a railway train could be stopped. Two trains were made up, one by the Brighton Company, and the other by the South Eastern, and laden respectively with about 32 tons of iron and other materials, fairly distributed over the carriages, that being calculated to be about the weight of 450 passengers. In order that these trials might have as much similarity as possible to an ordinary case of driving a train, the men in charge

of the trains were not allowed to pull up from the first instant the distance or semaphor signal eaught their eye, but at an arbitrary given signal, indieated at a moment when they might not be expeeting it.

Four trips were made between the junetion of the two lines. The first was a South Eastern train. It started, and, when traveling at the rate of 53½ miles an hour, Capt. Tyler gave the signal to stop, and the train was brought to a stand at a distanee of 2,077 yards from the point where the signal was given, and that simply by the driver shutting off his steam and the guard applying the two breaks attaehed to his van, without the engine having been reversed. The seeond experiment was with a Brighton train. The last mile was run in 66½ seconds, or at the rate of about 54 miles an hour, and the train was pulled up in 1,832 yards after being signaled to stop, by shutting off the steam, applying two breaks, and without reversing the engine, or in less spaee by 245 yards than the preceding train. The third trial was eonducted with a South Eastern train, and the object of it was to aseertain in what distance it eould be stopped by the applieation of the same means, and added to them, the immediate reversal of the engine after the signal to stop. The result was, that the train, while going a mile in 66 seeonds, was brought up at the distance of 1,790 yards, or in two minutes; but seven seeonds were lost in the application of the breaks by the driver not sounding his whistle until after he had reversed his engine. The fourth and last experiment was with a Brighton train, and, by arrangement, every available means was employed to stop on being signalled—namely, reversing the engine, shutting off the steam, applying the brakes, and eausing the engine to scatter sand along the rails. The effeet of all this was, that the train, while traveling at the rate of a mile in 63 seeonds, was pulled up in a minute and a half after the signal, and in the distance of 1,389 yards; thus showing that the applieation of the sand has a most important influenee to stop trains in an emergency.

RAILROAD IMPROVEMENTS.

Since the Count de Pambour, whose eareful practieal experiments and thorough mathematical analysis are yet unrivaled in any treatises on steam engineering, deseanted in glowing style upon the performances of the locomotive engine, this great agent of eivilization has far surpassed the imaginations of that aecomplished engineer. The "imposing spectacle" of moving on the straight, level lines of the Liverpool and Manchester and the Stockton and Darlington Railway "40 or 50 loaded earriages, each weighing more than 10,000 pounds," is now immensely exceeded in daily practiee on all the long roads in our country. Mountain grades are now surmounted on the lines of the Pennsylvania Central and of the Baltimore and Ohio Roads by the simple adhesion of the wheels, while but a few years since ropes and fixed engines were considered necessary even for hauling on levels. The empty freight car now weighs 10,000 pounds, and its load some 20,000 more. The ten-wheel engines of the Reading Railroad thunders steadily up grades of 21 feet per mile, with loads in coal alone of 500 tons each, and the seven-feet drivers on the Hudson River Road whirl passengers from New York City to the Albany

ferry-boats in 260 minutes. Less fuel is consumed per mile in the magnificent machines now employed on the New York Central Road than in the diminutive traps used ten years ago to pull half the present loads; and to compare still more recent dates, the working expenses on the New York and Erie for fuel, oil, and the like, have been steadily reduced within the last year some three or four per cent. with each monthly report.

This highly encouraging progress has been due partly to the adoption of absolutely new discoveries, but more to the better application of truths long known and published, but badly applied. School science is always both ahead and behind that of the workshop. While each has a mingled respect and contempt for the other, the liberal minds who can acquire, reconcile, and apply both are fewer than is generally believed. In practice improvements are introduced by slow and careful degrees.

Too high praise can not be awarded to Mr. D. C. McCallum, the superintendent of the New York and Erie Railroad, for the energy with which he has introduced on this great avenue of traffic a system of recording and publishing the results and methods of working its machines, which promises to place the locomotive in some degree on a par with the pumping engines of the Cornwall Collieries. James Watt, with his partners, manufactured Cornish pumping engines till 1800, and when his patent expired, one bushel of coal was capable of lifting twenty millions of pounds one foot high, or its equivalent in other work. From this time the "duty," as it is termed, or amount of work done, actually declined, until 1810, when the mining proprietors, alarmed at the fact, began to publish the duty of every engine, good, bad, and indifferent. Hereupon improvement commenced, and in 1834 the Fowey Consols engine pumped twenty-four hours in presence of a committee, raising one hundred and twenty-five millions of pounds one foot for each bushel of coal burned; and the average duty of all the largest engines is now nearly one hundred millions—an increase of four hundred per cent. in economy without any marked discovery in either the generation or use of steam.

These remarks have been called forth by a recent trial on a magnificent scale of the actual effect of a powerful locomotive in hauling a heavy train over the whole New York and Erie road, instead of changing engines and men at certain stations as usual. The road is usually worked in four divisions, and the chief design of the experimental train was to test the comparative difficulty presented by each to a heavy train moving east. A large number of cars were provided and loaded with lumber, and ample arrangements were made for moving, by other trains, all the cars left by the trial engine at each station. Every up grade was tried with big loads, which were gradually diminished till the exact limit was reached at which the train could proceed, in consequence of which much of the ground was many times traveled, and the whole experiment consumed nine days' time. The width between the rails on this road is 6 feet, that of a great majority of roads being only 4 feet 8½ inches; and many contend that the resistance to motion on curves is increased with each increase of width, an opinion which, although apparently well founded in theory, this experiment has done little to establish. Although frequent experiments of this kind have been tried at various times on long

lines of narrow roads, this is the first to our knowledge on a 6 feet gauge, and we doubt whether a train half a mile in length and weighing in toto nearly or quite 1,800 tons has ever before been hauled over a road as crooked as the Delaware River portion of the Erie by a single engine. The smallest radii of curves on the whole line is 955 feet, and the greatest inclination 60 feet per mile. The most difficult points of course are those in which curves and grades are combined for long distances or at frequent intervals, and the equation of grades, curves and distances form some of the most perplexing problems ever presented to the civil engineer. The smallest number of cars hauled at any time was 22, and this was where a curve 1,294 feet long and 1,146 feet in radius was combined with the maximum grade of 60 feet per mile. The engine, No. 210, which hauled 100 cars at a speed of 6, 8, or even 14 miles per hour on levels and up grades of 6 feet per mile, combined with curves in many instances, as also through curves of 955 feet radius on level points on the Delaware, stuck fairly in the five-degree curve above mentioned, but started again and went through after being pushed about half a rod by another engine; a fact indicating a very close balance between the power and the resistance.

Experiments on the resistance opposed to motion on railroads are yet very indefinite, and any data from this experiment may be of some value. The variable elements are so numerous and complex that probably no two experiments have ever been made under precisely similar circumstances. Even the wind exerts an influence which is difficult to compute, and it is not yet agreed whether a head or a side wind is most objectionable, as the latter blows out and continually replaces the air contained between the cars. The speed has evidently a very great influence on the resistance of the air, and by more rapidly consuming the steam affects very seriously the ability of the engine to haul with great power. The absolute highest pressure in the boiler of No. 210 with this train was 165 lbs., or 150 above the atmosphere, and probably the average pull on the couplings of the forward car, in the tightest places, was about 15,500 lbs., or equal to more than one third of the whole weight on the driving-wheels. It is only by a liberal flow of sand upon the rails that the wheels can be prevented from slipping under such circumstances, and it may be remarked that the wheels, when once slipping, have a most discouraging property of polishing the track. The only safety in a very severe pull is in a dry, gritty rail, well sprinkled with sharp sand. The engine which was employed in this experiment is a most extraordinary machine, and is perhaps only equaled by three others on the same road, built from the same patterns. The design was by James B. Gregg, Esq., of Susquehanna, and the whole weight is 66,000 lbs., of which 4,000 lbs. are supported by the two pairs of driving-wheels, and 26,000 by the truck. It is outside connected, the cylinders being 17 inches in diameter, with 24 inches stroke of piston. The valves are worked by the link motion, and when moving very slowly the steam acts nearly at full pressure for 23¼ inches of the stroke. With no means of testing directly the actual pull on the train or even of approximating it by finding the average pressure in the cylinder when working expansively on level portions, we despair of settling any vexed ques-

tion by aid of these results, and can only regret that some means were not devised for ascertaining both these quantities, as well as the actual quantities of water evaporated at short intervals.

The performances of this engine, as above recorded are among the most extraordinary recorded in the history of rail-road engineering.—*N. Y. Tribune.*

IMPROVEMENTS IN RAIL-ROAD APPURTENANCES.

Improved Air-Spring for Rail-road Cars.—An improved air-spring has recently been introduced on the Baltimore and Ohio Rail-road, of a novel construction. The elastic material employed is common atmospheric air, and the peculiarity of the invention consists entirely in the method of confining it. The old air-springs employed to a considerable extent on some roads, a few years since, consisted of a vertical cylinder, opened at the bottom and furnished with a piston thrust up from below. It was abandoned in consequence of its unavoidable leakage. The present spring consists of a similar cylinder, or rather rough cup in an inverted position, provided with a flexible but air-tight partition or diaphragm across its under side, and against the under surface of this a suitable rounded mass of wood is allowed to press. The air is compressed in the cup by the aid of a small hand-pump, and the irregularities of the track cause the diaphragm to be bent alternately inward and outward, so that the whole weight is supported on the cushion of air, yet without allowing the least possible chance for the escape of the fluid. The diaphragm is composed of several thicknesses of India-rubber, stout canvas and leather, and as a still further protection is covered on the inside with a stratum of good *sugar-house molasses*, so that the air, in fact, acts against a fluid piston. The cast-iron cup is lined on its top and sides with tin to prevent the possible escape of air through its pores, and the air, although compressed to a density of some 150 pounds per square inch, is found in practice to be completely and perfectly retained, while the motion of the car is, as may be supposed, of the gentlest possible character. There is no friction, and the only part of this spring which can fail is the diaphragm, which can be easily and cheaply replaced when necessary. One of the most attractive qualities belonging to this invention is its cheapness, a set for car, complete, costing only about $40 or $45, while the steel springs frequently employed cost about twice as much, and the now popular rubber springs cost from the like amount to $150.

Conical Plate Rail-road Car Springs.—These improved springs, patented by Speed & Bailey, of Detroit, Michigan, are simply concave steel plates, resembling, in outward appearance, the saucers of common coffee-cups. These disks are placed within a case or cylinder, the lower disk resting, like a saucer, on the bottom of the cylinder; the disk next above is reversed or placed bottom up, its periphery resting on the periphery of the lower disk. In this manner the disks are arranged in pairs, above each other, a plunger being fitted to the top of the cylinder, on which the weight to be sustained rests. It is plain that the elasticity of the disks, thus arranged, will be considerable, and that they will yield more or less, according to the weight brought upon them.

Disk-springs of this kind have long been known; they are peculiarly adapted to car-springs, for they occupy no more space than the round India-rubber springs now in common use. But the trouble with the old-fashioned disk-spring is that, after being in use for a time, they split and flatten out, thus losing their elasticity and becoming worthless. The improvement of Messrs. Speed & Bailey consists in corrugating the disks, instead of having them plain as heretofore. This invention adds new strength to the plates, and entirely obviates the serious objections we have just named.

Adams's Car Spring.—In this new car-spring the inventor, Mr. Adams, of New York, employs simply disks or circular pieces of cast-steel, between which he lays circular plates of cast-iron. The latter are alternately convex and concave; that is, first thick at the edge, and next thickest in the middle, the whole being confined within a case of cast-iron. Thus the weight of the car is continually striving to bend each plate into a slightly dishing form, and the elasticity and strength are so proportioned to the degree of curvature that they may be compressed to a fair bearing before the plate of steel will be so much distorted as to receive a permanent "set." In case, however, such an event should occur, and that one or more of the plates in a series should become permanently dished, the only result will be to carry the car somewhat stiffer until, at a proper time, the springs can be removed, when a few skillful blows bring it into its original flat condition.

One great point in this spring is the ease with which it may be lightened or strengthened at pleasure, to adapt it to any kind of car or to any situation desired. The same case, which is merely a cylinder open at the base, may be made to contain a stiff or easy spring by increasing or diminishing the number of steel disks between each alternate cast-iron plate. The springs now in use are about 5 inches in diameter outside the case, and 6 inches high when extended. A motion of about 1½ inches is provided for, which would make the spring, when entirely compressed, about 4½ inches high. The plates of steel are No. 20 by the wire-gauge, or considerably less than one sixteenth inch thick, and it is preferred to place a few single, others double, treble, etc., so that the spring will be equally elastic whatever the load in the car. The spring can certainly be constructed very cheaply, as the castings require no finishing, and the plates of steel are so light as to be of little moment so far as expense is concerned. The only question on which doubt may be felt is the durability, as each depression of the center of the disk must cause a motion or rubbing of the surfaces at the edges; a friction which, under so great a pressure, may be supposed gradually to wear away both the metals.

Miller's Steam Car Brake.—In this invention by Mr. Henry Miller, of Detroit, the cars are stopped by friction upon the wheels in the usual manner, but the brakes are applied by the aid of steam from the boiler. Ordinary hand-wheels are provided as usual at the ends of the cars, but except in case of derangement or in switching the necessary pressure upon the brakes is obtained in all cases—ordinary as well as extraordinary—from a piston confined in a horizontal cylinder under the center of each floor. Every car is provided with a pipe running lengthwise, and with a piece of strong flexible hose to connect the same with that of the next one. This pipe supplies steam to one

end of the cylinder, and thus drives the piston toward the other end, tightening all the brakes by its connection with the usual compound levers. Turnbuckles are provided, by which the rods may be taken up to compensate for wear. The brakes are of the usual proportions, shod with iron; the cylinder is six inches in diameter; the stroke or motion allowed the piston is ten inches, and the diameter of the pipe one and a half inches. The pipe connects with the upper portion of the boiler, and a lever is provided by which the engineer allows steam to flow for a longer or shorter time, then closes the valve and allows the steam to act by expansion. By turning the lever in another position, the steam in the cylinder and pipe is discharged into the atmosphere, and the brakes immediately released, so that the friction may be taken off and let on again, with any required degree of strength, several times in a minute if desired. Wheels should never be entirely stopped while the train is in motion, as the slipping on the rail is very injurious; and by properly proportioning the parts, a very close approach to this resistance may be obtained without ever exceeding it.

A small self-acting valve, opening inward, is provided in the lowest part of the pipe, under each car. This valve is operated by a spiral spring, and opens the moment the steam is discharged. It allows all the water to dribble out at leisure, and keeps the whole always ready to act in the coldest as well as in the warmest weather. The invention has been tested on the Michigan Central and other lines in the West, and has been recently introduced on the New York and New Haven road. In case of sudden danger it allows the engineer to put on the brakes in a second of time, and again to release them as quickly, if he discovers his fears to have been unfounded. The steam consumed is usually taken when it can best be spared as the engine approaches a station, and is found too small in amount to be of any importance. The strain being necessarily equal on every brake, the banging of cars together is entirely avoided, and the elasticity of the steam renders the action of the brakes in every respect smooth and uniform.

A rail-road brake, embracing some novel points, has recently been introduced upon the Orleans (France) road. The objection to the ordinary hand-brake is, that it requires half a dozen turns before taking effect, and that its efficiency depends upon the watchfulness, vigor, and constant attendance of the brakeman. There is no certainty that the six or eight brakemen upon a train invariably, immediately, and simultaneously bring their forces to bear. The new instrument is such that the greater the speed and weight of the train, the greater its effect. Each car is fitted with one, which has no need of any one to manage it. Upon the tender is an ordinary brake of the old construction, which is put down by the stoker as the engineer turns off the steam. The result is to bring all the cars down upon the engine, with the whole weight of the momentum acquired. They press upon each other. and this pressure—the tender resisting powerfully, as its wheels are no longer turning, but sliding—is sufficient to put the instrument into play, and the wheels of the whole train are almost immediately blocked. The stoppage of movement is prompt, without being sudden, and the entire control of the train is centered where it ought to be, upon the engine.

Hydrostatic Rail-way Brake.—The following is a description of a hydrostatic rail-way brake recently introduced upon the Shrewsbury and Hereford Railway, England:—The brakes themselves are upon the usual principle, but are placed upon every carriage, instead of on one or two only. A cylinder is fixed under the carriage, 4½ inches diameter and 3 inches stroke; and in this cylinder is fitted a solid piston, the rod of which is attached to the lever of the brake. Into each side of the cylinder is screwed an iron tube, one inch in diameter, and terminating at each end of the carriage with a joint of a novel character. When the carriages are connected, the tubes are made continuous by inserting into those joints a flexible tube between each carriage; and when the engine is attached to the train, that is also connected by a flexible tube, leading into tubes fixed in the bottom of the tender, which tubes are merely for the purposes of reducing the temperature of the water used in applying the brakes. The boiler is fitted with a stop-cock near the starting lever, and from this cock is a tube connected to the tubes in the tender. When a train is made up, and the engine attached, a cock inside the tender is opened, and the tubes throughout the train are allowed to fill themselves with water; water being only compressable to the extent of one inch in the 15,000, is always ready to be acted upon at the moment. At the present day, locomotives are worked at pressure of from 100 to 150 lbs. per square inch; but for example's sake, we will take the lowest figure; therefore, with the cylinders before described, a power of 1,500 lbs. is given to each brake, no matter what may be the number of carriages in the train. The cylinder to work the tender brake is 4½ inches in diameter, with a 6 inch stroke, and gives a force of 3,000 lbs. The mode of bringing the brakes into use is this: The engine driver shuts off his steam, opens the cock named in boiler, and in one second the whole of the brakes are on the wheels, and are taken off by the driver shutting the cock in the boiler, and opening the one in the tender.

Dick's Self-acting Switch.—The switch is designed to be operated in all respects like the ordinary ones, with the additional property of springing instantaneously into line when, in consequence of any misunderstanding or carelessness, a wheel approaches in the wrong direction upon the main track. This property was put to a most unprecendented and almost fool-hardy test on the 27th of June last, by running a train at the highest possible speed across not only one but all the switches in nearly a hundred miles of track, *all designedly placed wrong.* The Buffalo and New York City railroad, 91 miles in length, had adopted this invention throughout, and over this whole line the newest and smartest engine was driven with two passenger cars, accompanied by some of the principal officers of the road, to observe, or rather to experience, any effects which might follow a failure. Fifteen miles of this route, *over three of the gaping switches*, was performed in 17 minutes; showing a very high degree of confidence in the infallibility of the invention. The principal peculiarities of this switch consist in two elliptic springs, a lever, and a catch, which are all to be considered as additional to the usual mechanism of a switch, but increasing the cost only some 25 or 30 dollars. The heaviest of these springs is just outside the track, between the rails and the switch-stand, and exerts a constant effort to throw the switch into such position as to make

the main line continuous and perfect. When the switch is moved out of this position by the hand-lever, the second and smaller spring comes into play and throws forward a bolt which catches and holds the switch in place, and at the same time elevates an aforementioned lever, which is just within the track, some sixteen feet distant. In case of the approach of a car or engine in the wrong direction, the flange of the wheel presses upon the lever, detaches the catch, and the switch-rails jump into place with considerable energy. At a speed of 60 miles an hour, a locomotive moves 88 feet per second, and the catch is consequently released only one fifth of a second before the wheels enter the switch, yet the movement is invariably completed in time.

Bailey's Adjustable Car Seat.—In this improvement which allows the seat to be adjusted at pleasure, so as to form an upright seat or an almost reclining lounge, the seats and backs are connected to each other and to a fixed frame of cast-iron by rods or links which allow a corresponding motion to each, and the parts are so balanced by a very simple and substantial arrangement that the passengers by simply throwing their bodies backward or forward with a moderate degree of force, may change the position of the back to any angle required. The seat proper is always horizontal, the back alone being changeable in its degree of inclination. It is difficult to convey, without the aid of engravings, a very distinct idea of this improvement. To attempt it, however, we should divide the whole into four, or rather six, distinct parts. 1st. The fixed frames, one at each end of the seat, and rising to a point about midway between the seat proper and the arm-rests. 2d. The arm-rests, two in number, entirely distinct from, and independent of, the frames. 3d. The seat; and 4th. The back. The seat, back and arm-rests are neither of them fixed firmly. The seat is suspended to the frame by two vertical links at each side, which links are continued upward and support the arm-rests at their upper extremities, the whole being loosely jointed together at each connection by a suitable rivet. Two additional links at each end of the seat, jointed one to the seat proper and the other to the arm-rest, extend horizonally backward and take hold of the back. With this arrangement, by the aid of the flexible joints, the relative position of all the parts may be easily adjusted. A "friction-piece" is provided at the wall-side, which presses with considerable force against the end of the seat, and assists it in retaining any position given it, however loose the riveted joints may become by reason of long-continued wear or bad workmanship. But for this "friction-piece" it will be readily seen there is no wear of any parts except in the rivet-holes; and the frames, links, arm-rests, etc., may be made as ornamental as desired, or may be bronzed or gilded at pleasure. This seat appears, on rather a brief examination, to be entirely free from any of the faults appertaining to the previous forms of adjustable seats. It is readily reversed by simply lifting over the back, which is upholstered on each face, and the liability to derangement or fracture seems to be reduced to the lowest practicable amount. Provision is made for preventing the possibility of injury to the hands of infants or others in suddenly changing the position of the seat, and one of its greatest recommendations is, the fact that no catches or other derangeable or perplexing fastenings are required.

Sleeping in Rail-road Cars.—Mr. S. Culver of Newark, Wayne County, N.Y. has invented a very simple and comfortable apparatus by which a traveler can sleep in a rail-road car without any of the inconveniences usually attending that recreation. The apparatus consists of a bit of welting fastened by a hook to the roof of the car, with a net at the end in which the head can be laid at any elevation or angle desired. It is a most ingenious contrivance, and so light as to be easily carried in one's pocket.

Replacing Cars off the Track.—Mr. S. P. Coon of Milwaukie, has recently patented a device for moving cars, which, although operating slowly and by man-power alone, appears to be a decided improvement, on the usual process for putting cars on track again after a rail-road accident. Our first impression was decidedly unjust, it appearing to possess little novelty; but in practice it has since been demonstrated to work with more ease, certainty and rapidity than any other (if we except the practice on some of the coal rail-roads of jerking the wrecks unceremoniously out of the way, perferring to smash a few cars rather than detain another train for a single moment). Coon's apparatus consists of hand-screws somewhat like screw-jacks, which are made readily applicable to a common T rail, by slipping the clamp on over the ends, so that by placing a rail transversely under each truck and applying the screws at each side the car may be safely lifted without guys, and entirely supported on the cross rails. In this situation, suitable small rollers being previously provided between the swing beam and the rail, the car may be readily moved sidewise by a rope and a small windlass fitted on an end of each. The great difficulty arising from the disposition of the trucks to swivel about on their centers is completely avoided by this process; but in case any slight degree of deflection in this respect may be required by the circumstances, it may be given by bending the rail before screwing up.—*New York Tribune.*

Improved Car Coupling.—Mr. D. A. Hopkins of Elmira, N. Y. has recently patented a cheap, durable and simple drawhead, which may be made self-coupling or otherwise at pleasure. The end or face of the drawhead is of cast iron, and somewhat heavier than the wrought iron ones usually employed. The mouth is flaring or funnel-shaped, which allows the link to stand at a considerable angle when necessary. The link is held by pins in the usual manner, but the chief advantage of this invention consists in the introduction of a piece of iron immediately behind the pin, which piece is pressed forward by a slight spiral spring. The pressure of this piece against the end of the link is sufficient by the aid of a narrow throat to maintain the link at any elevation desired, so that in coupling the link may be adjusted to meet the mouth of the opposite drawhead. To make the opposite drawhead self-coupling it is only necessary to partially withdraw the pin, so that the spring piece shall pass under its extremity and support it. As the cars come together the link enters its mouth, presses back the spring piece, allows the pin to drop into place, and the union is completed.

Foote's Car Ventilator.—The principle of this ventilator, which has been introduced on the New York and Erie Rail-road, is as follows:—In the center of the car, underneath the floor, is a transverse tank, containing twenty-five gallons of water. On each side is a case, with glass windows, reaching from

the floor to the ceiling, inclosing a force-pump, worked by being geared to a wheel of the car, which throws a beautiful jet of water inside the case, and is carried back into the tank by a waste-pipe; thus the water is used over and over again without waste. At the top of the case is an aperture through the roof, to which is fitted a double bonnet, fronting each end of the car, through which air is admitted into the case—the water abstracting all particles of dust and other impurities—whence it is conducted to a trunk running the length of the car, opening by means of several grates up into the car—thus furnishing a constant supply of fresh and pure air. The quantity of air admitted is regulated by a simple register, which can be turned by any one of the passengers. The air escapes at the will of the passenger by opening a little door in the window at his side; and though the air is constantly passing out, yet there is no perceptible current until within two or three inches of the little door.

Prevention of Dust in Railroad Cars.—Mr. William H. Muntz, of Boston, Mass., has invented an improvement in railroad cars, for preventing the rise of dust. It consists in running a line of perforated pipes along the outside of each car, in such a manner as to permit the simultaneous discharge of many jets of water, in a lateral direction. These jets are intended to spurt out 10 or 15 feet from each side of the car, forming a fine rain to prevent the rise of dust. The tank for supplying the pipes will be carried on a separate truck, or each car may be furnished with its own reservoir.

Railway Sanding Apparatus.—This improvement, recently introduced into England, consists of a sand-holder fixed in front to the engine framing, directly above the rail, and having a conical bottom upon which the sand rests. Within the holder is a valve, suspended by a cord, running along the side of the engine, and which, by a simple arrangement, is placed under the complete control of the engineer. The end of the sand-holder terminates in an India-rubber tube, which not only prevents the scattering of the sand by the wind, but also prevents fracture in case of meeting with any obstacle.

Independent Wheel Broken Frame Safety Truck.—Mr. C. R. Disbrow, of Bath, New York, is the inventor of a very desirable improvement in car construction, of which the above is the verbose and somewhat terrific cognomen. The term broken frame, suggestive of any thing but safety to the uninitiated, refers to the fact that the frame is divided longitudinally in the middle, and only connected by an extra axle running across the center—a construction which allows each half to oscillate vertically without affecting the other, and enables the car to ride over all the ordinary inequalities of the road with a steadiness previously believed to be unattainable. A "caboose" car, running on the Buffalo, Corning, and New York Rail-road was lately fitted with this improvement, and its practicability perfectly demonstrated, the car being found to run with such steadiness that writing could be executed in a very tolerable manner in its interior, even at high velocities. There are four wheels in each truck, arranged in their usual positions, but the axles are divided in the middle, so as to allow each wheel to turn independently of its mate, thus overcoming the tendency to twist and fracture the axle, and to grind the flanges against the rails in turning curves on the road. Each truck is neces-

sarily provided with an extra axle (which may be very cheaply fitted, as there is but very little motion), and four extra boxes or bearings.—*New York Tribune.*

A passenger car, constructed of hoop-iron, has been recently introduced upon the Sixth Avenue (New York City) Rail-road. The car is somewhat in the shape of a coach body, with an entrance for passengers at either end. It is made of hoop-iron, banded together like lattice-work, and weighs about 3,500 pounds. It is considerably lighter than the ordinary wooden car, and is easily drawn by two horses. The cost of the car in question was about $1,500.

APPLICATION OF STEAM FOR AGRICULTURAL PURPOSES.

At the Annual Exhibition of the Royal Agricultural Society of England for 1855, an unusual degree of interest was excited in respect to the exhibition of machines intended to illustrate the application of steam to agricultural purposes. For portable steam engines adapted to farm use, eight entries were made, of eight, seven, and six-horse power. The prices ranged from $900 to $1300; the cheapest engine of eight-horse power being entered at a cost of $900. In the trials, the getting up of steam involved a consumption of from 18 to 24 pounds of wood, and from 18¾ to 35 pounds of coal, in spaces varying from 39 to 66 minutes. The quantity of coal consumed (per pound) per horse, per hour, varied from 3½ to 10 pounds. The prize was awarded to an eight-horse portable engine, costing $1,250, consuming, in getting up steam, 24 pounds of wood, or 28 pounds of coal, in 66 minutes, or $3\frac{6}{10}$ths pounds of coal per horse-power, per hour, when in full operation.

For the prize of £200 offered by the Society for the best steam-plow, tractor, or cultivator, several machines were entered. The most remarkable machine of this kind was a steam "horse" or "tractor," of fourteen-horse power, exhibited by Mr. Boydell. This is a carriage that takes its own railway along with it—rails, plank-bearings, and all—and keeps putting down and taking up its track as it proceeds. This strikes one at first like the idea of getting into a basket and lifting yourself by the handles, but the editor of *Chambers's Journal* has seen the machine operate, and thus describes it:—

"It is evident that a flat deal-board will not, weight for weight, sink so far down into a bed of mud as will the narrow tire of a cart-wheel. It is evident, too, that cart-wheels may have a railway tire or edge, instead of an ordinary tire or edge: and that a line of rails admits of being laid down upon a wooden plank. A person, likewise, may readily conceive the idea of laying down one of these rail-planks under each wheel; and this, indeed, is very much like what is ordinarily done in the construction of a common railway. The problem, therefore, was this: to construct the wheels in such a manner, that by means of certain mysterious-looking levers, pins, screws, and iron arms, these railway-planks, when passed over by the wheels, should be taken up by the machinery, and laid down in a new spot; and this problem has actually been solved. Each wheel admits of being represented as consisting of a circle inscribed within a hexagonal frame of flat boards, each furnished with railway

trimmings. If the hexagonal frame be supposed cut or divided into six component planks, one of these planks laid down beneath each carriage-wheel, and the carriage itself pushed forward, there would be supplied for it a short railway, having a length equal to the length of each plank; and the carriage, having run on to the extremity of the rail-planks, might easily be transferred to another pair, if they could be placed in due opposition with the last. In this manner, by means of two sets of alternating planks, the carriage might be made to run to any required distance. Now, this is just that which is accomplished by the rotation of the wheels themselves in the carriage under consideration; only, instead of the alternation of two pair of planks merely, the changes are played on no less than six pair, one pair alone being in plane contact with the underlying ground at one time."

At the exhibition this machine ran itself from the show-yard, over some difficult and steep road, to the trial-field, and there went through the operations of plowing, scarifying, and harrowing, with very fair success. Its performances seemed to stagger some of the old sticklers for things as they are, giving a pretty broad hint that steam was insensibly coming closer to the farmer.

Another steam-plow, invented by Messrs. Fisker, of England, was exhibited on the same occasion, and is thus described in the *London Agricultural Gazette*:—

"The whole apparatus is novel, and, we may say, uncommonly promising. Instead of a heavy wire rope to drag the plow frame by main force, a light, endless hemp rope, only three eighths of an inch thick, communicates power to the plow carriage, which we may call locomotive, as it propels itself in the following manner: a grooved wheel set in motion by proper spur-wheels from the rigger actuated by the hemp rope, winds, as it were, along a strong wire rope laid upon the ground; and the frame, being thus carried slowly forward, drags plows or other instruments after it. The hemp cord does not touch the ground, but is held up at every forty yards' distance by a 'horse,' or small friction pulley-frame, about three and a half feet high. This cord travels at the rate of twenty miles per hour; but the speed being reduced by the wheel-work upon the plow carriage, the latter travels only two miles per hour. When two plows are in work at once, having the draught of four horses, the strain upon the rapidly-running cord will thus be less than half a horse's draught. We were informed by the exhibitor that a four-horse engine is sufficiently powerful to work two plows, and that with four hundred-weight of coal it will plow four acres in a day, the expense for labor being only that of two men and a boy. If this be strictly the fact, we have a complete invention able to plow light land at a cost of say 3*s.* per acre. That is not far from the truth we are sure, for we ourselves saw one plow drawn at the rate of at least two miles per hour when the engine had only seven pounds' or eight pounds' pressure upon the square inch, and this was an engine of six-horse power at 40 pounds pressure. To be sure, the land had been previously plowed, pulverized, subjected to the trial of all sorts of drills, and been afterward well trampled by hundreds of people, and consolidated with rain, so that the possible quantity and quality of the work could not well be ascertained.

The plowing we saw was respectably though roughly done, but there was one point really performed—the furrows were well turned. If a steam cultivator can invert the soil thoroughly and cheaply, we may put up with a little imperfection in the straightness of cutting and evenness of laying. The method of anchoring the pulleys, and the arrangement of the pulleys and ropes, is very ingenious, and can hardly be explained with brevity. The anchorage consists of a plate or plow, a few feet in length, and eight inches only in depth; this can be easily drawn forward in the ground without the trouble of digging holes, taking up, setting down again, etc., and yet it presents a sufficient resistance sideways to the pull of the ropes. A wheel, pinion, and crank, on each anchor is used to draw it by means of a rope toward a fixed post, when it is required to be shifted. The arrangement of the ropes about the anchored pulleys is like that of the chains in a traveling crane, the anchorage being shifted forward at intervals without altering the length of the rope. The plows are not rigidly attached to the traveling frame, but are hung by short iron beams, which form levers, having a slight degree of play up and down. There are four plows—two before and two behind the carriage, pointing opposite ways, a neat lever movement lifting two out of work and dropping the other pair of plows in; so that the machine can plow both ways without having to turn round at the land's end."

IMPROVEMENTS IN THE MANUFACTURE OF STEEL.

An important movement has been made in Rockaway, Morris County, New Jersey, for the manufacture of cast-steel directly from the ore, without the old process of converting the ore into iron and baking this iron into steel before converting it into cast-steel. The idea is not a new one of making steel directly from the ore, but it has been deemed impossible to produce a uniform and cheap product. Improvements have, however, been recently made by Dr. Smith, of Rochester, and a company has been formed for practical working on a large scale.

The process of converting the iron-ore into steel resolves itself into a series of means to make the ore as pure as possible without the expense of smelting. For this purpose the best ore is selected to start with, this is stamped and ground very fine, and after this it is run through magnetic machines, washed thoroughly, etc. After being dried, it is baked in a manner very similar to the ordinary way of baking bar-iron into steel. This is merely a brief outline of the process by which they expect to escape much of the drudgery and expense attendant on the old method.—*New York Tribune.*

RULE FOR CALCULATING THE WEIGHT OF A CASTING FROM THE WEIGHT OF ITS PATTERN.

It is evident that the weight of a casting stands in the same proportion to the weight of its pattern as the specific gravity of the former to that of the latter, allowing, at the same time, for the shrinking, *i. e.*, contracting of the casting in cooling. The following data are taken from an article of Professor

Karmarsch. Average specific gravity of materials used for patterns: Pine-wood, 0·500; oak, 0·785; beech, 0·721; pear-tree, 0·689; birch, 0·664; alder, 0·551; mahogany, 0·600; brass, 8·300; zinc, 7·000; tin (3 to 4 tin 1 lead), 7·900; lead, 11·000; cast-iron, 7·250. Compositions, red metal (10 to 15 per cent. zinc), 8·600; bronze (copper, tin, and zinc, zinc and tin together 15 to 20 per cent.), 8·450; bell-metal (zinc and tin 20 to 25 per cent.), 8·900; cannon-metal (tin 5 to 10 per cent.), 8·760.

The shrinking or contracting in cooling, is;

For brass	1 from 21
For bronze	1 from 26
For zinc	1 from 27
For cast-iron	1 from 32
For cannon metal	1 from 40.

This means that 21 cubic inches of melted fluid brass will, after cooling, occupy only 20 cubic inches.

If s is the specific gravity of the pattern, S specific gravity of the casting, a the ratio of shrinking, P weight of the pattern, and C the weight of the casting, the rule is:

$$C = \frac{P\,S\,(a-1)}{s\,a}$$

The following table gives the numbers with which the weight of the pattern is to be multiplied to obtain the weight of the casting, nearly:

The pattern made of	THE CASTING MADE OF						
	Cast-iron.	Brass.	Red metal.	Bronze.	Bell-metal.	Cannon-metal.	Zinc.
Pine-wood	14·0	15·8	16·7	16·3	17·0	17·1	13·5
Oak	9·0	10·1	10·4	10·3	10·8	10·9	8·6
Beech	9·7	10·9	11·4	11·3	11·8	11·6	9·4
Pear-tree	10·2	11·5	11·9	11·8	12·3	12·4	9·8
Birch	10·6	11·9	12·3	12·2	12·8	12·9	10·2
Alder	12·8	14·3	14·9	14·7	15·4	15·5	12·2
Mahogany	11·7	13·2	23·7	13·5	14·1	14·2	11·2
Brass	0·84	0·95	0·99	0·98	1·02	1·03	0·81
Zinc	1·00	1·13	1·17	1·16	1·21	1·22	0·96
Tin	0·89	1·00	1·03	1·03	1·07	1·08	0·85
Lead	0·64	0·72	0·74	0·74	0·77	0·78	0·61
Cast-iron	0·97	1·09	1·13	1·12	1·17	1·18	0·93

If you wish to know the weight of a casting in brass from a pine-wood pattern, weigh the pattern—say 3 ounces—and multiply by 15·8×3=47·4 ounces; if cast in iron, 14·0×2=42 ounces.

MAKING STEEL TYRES.

At the works of F. Crupp, of Eisen, in Westphalia, tyres are formed of cast-steel in a very ingenious manner. A flat bar of steel is taken, two holes bored in the ends of the bar, and by powerful machinery is cut through from

hole to hole. It is then opened out, and between rollers a perfect tyre is made, without a weld. They have a tyre on exhibition at the works, which, after running 30,000 miles, presents scarcely any appearance of wear on its surface.

IMPROVED TUYRE FOR SMITHS' HEARTHS.

The following improvements in the construction of tuyres for smiths' furnaces, has been made by John Fernie of England. Mr. F., having observed the defects in the common water tuyeres, which in large fires were sometimes burned out in a day, found that, from the smallness of the water-space, steam was formed at the end, which drove the water back into the cistern, and it struck him, as an improvement, to make the space sufficiently large to allow a free circulation of the fluid, and thus prevent the formation of steam. The entire annular space round the nozzle of the blast-pipe, instead of being supplied with water from a tube only, is placed in communication with a large body of fluid by opening direct into the water cistern, which insures in all cases a good supply of water, and as that portion nearest the fire gets hot, it circulates, and prevents the metal getting too high a temperature. The first one on this principle was put to work in 1846, and proved eminently successful; it was a single casting, with the inner pipe for the blast, carried straight through to the back of the water reservoir. A modification was suggested, in which the tuyere was cast in two pieces—the one nearest the heat being fixed on a conical joint with bolts and nuts, which can thus be removed when burned out, and a new one supplied.

IMPROVEMENTS IN HEATING APPARATUS.

General Dembinski, of Paris, has recently patented some novel and ingenious arrangements for obtaining heat, to be applied to heating or warming rooms and large buildings, hot-houses, and to cooking and other purposes. The general principle adopted by the patentee, is such an arrangement of fluted or plain tubes, with tufts of wire passing through them, to be heated in any convenient manner, as, while hot, can have water continually to flow over or through them. The heated surface being extensive, in proportion to the water to be heated, keeps the latter in a constant state of ebullition, and by passing in that state through other pipes, so as to recirculate over the heated surface, great economy of fuel is estimated by the patentee to be the result. A large square or circular flattened vessel is connected with a smaller one by a tube of small diameter at their upper part, and by one of large caliber below; the steam and water, in a state of ebullition, pass along the upper pipe, and the water through the larger tube below, keeping up a constant circulation. In such case a single gas-burner only is employed, and the heated products of combustion so confined by a tube, as to heat the whole apparatus. There are various modifications of the arrangement, by which a whole suite of apartments can be heated with great facility. Ornamental vases, pillars, plinths, and other architectural and fanciful designs, may be made the heating medium in halls, staircases, single apartments, etc.

IMPROVEMENT IN FURNACES.

Dr. B. H. Washburn of St. Louis, has invented a method of feeding air to boilers, on the so-called "tornado principle." The arrangement is as follows: Two connecting cones or funnels are inserted in the doors of the furnace, which insures a steady draught, and gives the air the form of a whirlwind. The ash-pit is inclined at a good angle, reaching the bottom of the boiler from the door in the space of a few feet, and thus every particle of heat is saved and applied to the surface with the greatest intensity.

Smoke-consuming Furnace for Bituminous Coal.—Messrs. Haughgrove and Wheatly, London, have obtained a patent for a new furnace to consume the smoke of bituminous coal. The furnace is fitted with two sets of grate bars slightly inclining upward toward the back end. Between the front and back set of bars a hollow perforated movable bridge or partition is fitted, and connected with a lever, by which the fireman can move it up or down. When this bridge is depressed, access may be readily had to the back bars from the front ones. A bright glowing fire is kept in the back bars or grate by pushing back the incandescent fuel from the front one. After the back grate is supplied with glowing coals, the central bridge is raised, and all communication between the two fires is cut off, except through holes or perforations in the bridge. When fresh fuel is thrown on the front grate, a large quantity of unconsumed gases are immediately evolved, which, in passing through the perforations in the movable central bridge, are there mingled with a current of warm air coming from below the furnace through the hollow part of the bridge, and then pass in streams over the back fire, ignite, and are consumed—in other words, converted entirely into carbonic acid gas, with a great development of heat. A door is placed behind the furthest set of bars for the purpose of cleaning out the back furnace.

Macferran's Self-retaining Grate Bars.—These patent bars have mortices on one side and tennons on the other, at the part where the bars touch each other, so that when a set are placed side by side with the tennons of one fitting in the mortices of the next, it is impossible for one bar to rise above another. This preserves a uniform level at the top, and prevents them from warping.

Bow's Down-draught Smokeless Furnace.—In this furnace, devised by Mr. R. H. Bow of Scotland, the draught is reversed—that is, the flame, air, etc., proceed downward through and from the fire; and it is therefore, proposed to call it the "Down-draught Furnace." The principle of its action is very simple. The smoke, liberated from the superincumbent coal, is, by means of the suction of the chimney, carried, along with a due admixture of air, down through the brightly burning fuel which forms the lower stratum of the fire, and thus becomes intensely heated and completely burned. Contrary to what might have been expected, the combustion is very rapid; in some experiments made with a grate of $\frac{4}{5}$ of a square foot in area, the combustion was at the rate of 30lbs. of coal per square foot of grate per hour; the height of the chimney being nearly 35 feet. This result is probably due to the self-clear-

ing power of the furnace, and the comparatively dense state of the air when it mingles with the fuel. The combustion readily spreads upward to the fresh coal from the action of the strong radiant heat.

Gripper's Smokeless Furnace.—The principle of this recent (English) invention is that of mechanical motion applied to the bars, but different from anything yet introduced. Every alternate bar is so connected with a cross-piece at each end as to form one entire movable frame, which is connected by gearing with the motive power. The motion given to it is angular; first, the bars rise very slowly about an inch above the stationary ones, they then move gradually in a lateral direction toward the bridge, again sink in a vertical direction about an inch below the other bars, and then move laterally forward to their original position. What are termed the stationary bars are not fixed as usual but hung in such a manner as exactly to balance the vibrating frame with the load of fuel which it has to move, thus taking but little power from the engine to keep them in motion. The fuel is fed through a hopper and regulating incline plane, and the whole is self-acting, requiring but little attention from the stoker. We were informed that this apparatus has been in constant use about six months, that no difficulties whatever arose from the mechanical motion; there was an entire absence of clinker, nearly perfect combustion of the fuel was effected, and during our visit not a particle of smoke was visible from the chimney. Mr. Gripper estimates the saving of fuel alone at about 10 per cent., besides numerous other advantages.—*London R. R. Journal.*

ON THE CONSUMPTION AND ECONOMY OF FUEL.

The following paper on this important subject, with the notice of some new inventions connected therewith, was recently read before the London Society of Arts, by the well-known physicist, Dr. Neil Arnott.

Is it possible to avoid or to consume smoke—in other words, to produce a smokeless fire? Common coal (bituminous) is known to consist of carbon and bitumen or pitch, of which pitch again the elements are still chiefly carbon and hydrogen, a substance which when separate, exists as an air or gas. When the coal is heated to about 600° Fahrenheit, the bitumen or pitch evaporates as a thick, visible smoke, which, when it afterward cools, assumes the form of a black dust or flakes, called blacks or soot. If that pitch, however, be heated still more, as it is in the red-hot iron retorts of a gas work, or in rising through a certain thickness of ignited coal in an ordinary fire, it is in great part resolved into invisible carburetted hydrogen gas, such as we burn in street lamps. Now when fresh coal is thrown upon the top of a common fire, part of it is soon heated to 600°, and the bitumen of it evaporates as the visible smoke, which immediately rises. If the pitchy vapor, however, be heated to ignition by the contact of a flame, or of ignited coal near the surface, it suddenly becomes in great part gas, and itself burns as flame. This is the phenomenon seen in the flickering and burning which takes place on the top of a common fire. But if fresh coal, instead of being placed on the top of a fire, where it unavoidably must emit visible pitchy vapor or smoke, be intro

duced beneath the burning red hot coal, so that its pitch, in rising as vapor, must pass among the parts of the burning mass, it will be partly resolved into inflammable coal gas, and will itself burn, and inflame whatever else it touches. Persons often amuse themselves by pushing a piece of fresh coal into the center of the fire in this way, and then observing the blaze of the newly-formed gas.

Various attempts, beginning perhaps with Dr. Franklin, have been made to get rid altogether of smoke: one of the most recent of which was made by a London manufacturer, Mr. Cutler. He placed a box filled with coal under the fire, with its open mouth occupying the place of the removed bottom bars of the grate, and in the box was a movable bottom, supporting the coal, by raising which it was lifted gradually into the grate to be consumed. The apparatus for lifting, however, was complicated, and liable to get out of order, which with other reasons, caused the stove to be little used. The movable bottom rested on a cross-bar of iron, which in moving was guided by slits in the side of the coal box, and was lifted by chains at each end, drawn up by a windlass. Dr. Arnott then described a new fire grate somewhat on the above-noticed principle but more simple. The charge of coal for the day is placed in a box immediately beneath the grate, and is borne upward as wanted, by a piston in the box, which is raised by the poker used as a lever, and as readily as the wick of an argand lamp is raised by its screw; the fire is thus under command, as to its intensity, almost as completely as the flame of a lamp. There are notches in the piston-rod for the point of the poker, and a ratchet catch to support the piston when the lever is withdrawn. The coal-box of an ordinary fire may have a depth of seven or eight inches, which will receive from twenty to thirty pounds of coal, according to the area. In winter an inch or two more depth of coal may be placed over the mouth of the box before the fire is lighted, and in warmer weather the box will not require to be quite filled, that is to say, the piston, at the time of charging, needs not to be lowered quite to the bottom.

If it become desirable to replenish the coal-box it may be easily done, as follows: when the piston has been fully raised so as to have its flat surface flush with the bottom bar of the grate, a broad flat shovel is pushed in upon the piston, and it becomes at once a temporary floor to the grate and a lid to the coal-box. The piston being then allowed to sink, the lid is raised and the box filled with a new charge of coal, when combustion goes on as in the morning. This fire is lighted with great ease. The wood is laid on the upper surface of the fresh coal filling the coal-box, and a thickness of three or four inches of cinders or coked coal left from the fire of the preceding day is placed over it. The wood being then lighted, instantly ignites the cinder above, and at the same time the pitchy vapor from the fresh coal below rises through the wood-flame and cinders, and becomes sufficiently heated to inflame itself, and so to augment the blaze. When the cinder is once fairly ignited, all the bitumen rising through it afterward, becomes gas, and the fire remains quite smokeless ever afterward.

In the new grate, because no air is allowed to enter at the bottom of the coal-box—for the piston-rod fits its opening pretty accurately—there is no

combustion below, but only between the bars of the grate, where the fuel is so completely exposed to air, and near the mouth or top of the coal-box. The unsatisfactory results of some other attempts to make such a fire, have been owing in part to the combustion extending downward in the coal-box, because of air having been admitted below; and the consequent melting and coking of the mass of coal, so as to make it swell and stick, impeded the rising of the piston. A remarkable quality of this fire is its little tendency to be extinguished. Even after nearly all the coal in the grate has been consumed, the air will descend into the coal-box and keep the fire there gently alight, for a whole day without any stirring, and yet ready to burn up actively the moment the piston is raised. For the purpose of allowing a graduated admission of air, in order to ensure the maintenance of combustion with rather more activity, there is a slide in a small door at the front bottom of the coal-box. Before lighting the fire, whatever ash remains with this form of combustion, is removed off the piston. The fire is extinguished by allowing it to exhaust itself, or by lifting out the few lumps of coke or caked coal which remain. The charge should be such that enough cinder or coke may be left for the smokeless lighting of the next day. By the means above described, the production of smoke is obviated. We now come to consider the subject of the waste of fuel in ordinary fires. Count Rumford showed that $\frac{5}{6}$ths of all the heat produced in a common open fire passed up the chimney with the smoke, and therefore to waste; and he appealed in corroboration to the experience of those who use close stoves, which do not thus waste heat up the chimney, and where much less fuel than is needed in open fire suffices. As an exemplification of the above, Dr. Arnott gives the following striking illustration:—"I have an enclosed fire which, for 14 years past, has maintained for 24 hours, from October to May, a continued temperature of 60° or more, accompanied with good ventilation, by an expenditure of only 12 lbs. of coal, or about one fourth of that used in an open fire burning from 15 or 16 hours. The aperture by which the fresh air enters the stove to maintain sufficient combustion to warm the room is about three quarters of an inch in diameter."

If this be compared to the aperture of a common chimney-pot, which has a diameter of ten inches, and an area or size 150 times greater than the stove in question, and we take into consideration the rapidity with which a column of dense smoke filling that pot escapes from it when the fire is burning briskly; and reflects further that such column consists entirely of the warmest air from the room, blackened by a little pitchy vapor from the fire, there is proof of prodigious waste, and room for reasonable hope that a saving is possible. To see how a saving may be effected, the exact nature of the waste in such cases has now to be explained. A single mouthful of tobacco-smoke, on issuing, immediately diffuses itself so as to form a cloud larger than the smoker's head, and soon would contaminate the whole air of a room, as would also the smoke and smell of wood, paper, or other combustible burned in a room. Now, the true smoke of a common fire is not the whole of what is seen issuing from the chimney top, but only little dribblets or fits which shoot up or issue from the cracks in the upper surface of coal which forms the fire. These fits, however, quickly diffuse themselves like the tobacco-smoke in the air around

them, that is to say, in the large volume which fills the space left over a common fire. The whole of the air so contaminated, and which may be in volume 30, 50, or 100 times greater than that of the true smoke, is then all called smoke, and must all be allowed to ascend away from the room. It is evident, then, that if a hood or cover be placed over a fire, so as to prevent the diffusion of the true smoke or the entrance of pure air from around to mix with it, except just what is necessary to burn the inflammable gases which rise with the true smoke, there would be a great economy. This has been done in the new fire-place, with a saving of from one third to one half of the fuel required to maintain a desired temperature.

The stalk of the hood passes closely through a plate or other stopping through the bottom of the chimney, so that no air shall enter the chimney but through the hood; and there is a throttle-valve or damper in the hood-stalk, giving perfect control over the current of air that passes through. No part of the apparatus is more important than this valve or damper, and its handle or index must be very conspicuous, and have degrees of opening marked on its plate as clearly as the points are marked on a compass card. When the valve is quite open, the chimney acts to quicken the combustion, like that of a blast furnace, or like a forge-bellows, but, by partially closing the valve, the current may be diminished until only the most tranquil action remains. The valve should not be open in general more than just enough to let all the burned air or thin smoke, which is scarcely visible, pass through. When the valve is once adjusted to the usual strength of chimney action, it requires little change afterward. In many cases, it is desirable to be able to command and modify, by a movable plate, the size of the front opening of the hood or fire-place, as well as the opening of the chimney-throat. By the proper adjustment of the two, the desirable brightness of the front of the fire may be maintained. The chimney-flue above the upper opening of the hood should have its sides made slanting, so as not to harbor dust or any soot which, from any careless use of the fire, might be produced. The size of the chimney-flue is not important. Other great evils of the present open fires are that there are great irregularities and deficiencies in their heating and ventilating actions, which bear so powerfully on the public health. The hood and its damper, by influencing these, may appear, perhaps, of more importance than as saving the fuel. This arrangement, by allowing so small a quantity of air to pass through in comparison with what rises in an open ordinary chimney, lessens in the same degree the cold draught of air toward the fire from doors and windows, and which are common causes to the inmates of winter inflammation and other diseases; and for the same reason, the heat once radiated from the fire toward the walls of the room, not being again quickly absorbed and carried away by such currents of cold air as are referred to, remain in the room, and soon renders the temperature of the whole more equable and safe. Still more completely to prevent cold draughts approaching from behind persons sitting around the fire, the fresh air from the room is conveniently admitted, chiefly by a channel which leads directly from the external air under the floor to the hearth, and there allows the air to spread from under the fender. The fender, exposed to the fire near it, becomes hot;

the cold, fresh air then rising under it takes from it the excess of its heat, and so becomes itself tempered, before it spreads in the room. The importance of general ventilation again is strikingly illustrated by an occurrence which happened not long since in Glasgow. A large old building which had been formerly a cotton-mill, was fitted as a dwelling-house for persons of the working-classes, and had nearly 500 inmates. Like all foul and crowded human dwellings, fevers and kindred diseases soon became prevalent there. After a time a medical man, who was interested, obtained permission from the proprietors of a neighboring chemical works, in which there was a lofty and very powerful chimney, to make an opening of one foot in diameter into the side of the chimney for the ventilation of the lodging-house. He then connected with this a main tube from the lodging-house, which had branches running along all the passages or galleries, and from the ceiling of every separate room a small tube communicated with these branches. Soon after, to the surprise as well as to the delight of all concerned, severe diseases entirely disappeared from the house, and never returned.

Now the chimney of the new fire-place, although not very tall has a ventilating power scarcely inferior to that of the Glasgow Chemical Works. The arrangement of the hood with its valve, as above described, by allowing only unmixed and very hot smoke to enter the chimney, instead of, as in common chimneys, smoke diluted with many times its volume of colder air, increases the draught just as it does the heat of the chimney, and through an opening then made into the chimney from near the top of a room, all the hot, foul air in the room, consisting, perhaps, of the breath of inmates, smell of meals, burned air from candles, lamps, etc., and which else accumulated and stagnated at first near the top of the room, is immediately forced into the chimney and away. This is strikingly proved by placing, near the ventilating opening, a light body, as feathers or shreds of paper, suspended to a thread, and seeing with what force it is drawn into the opening.

ON THE CONSUMPTION OF SMOKE.

The subject of the consumption of smoke continues to be frequently discussed in most of the scientific journals and circles of England. Mr. Muir, in a communication to the Society of Arts, states that the statements often made, that from seventy-five all the way down to ten per cent. of fuel can be saved by the consumption of smoke, are not founded upon any reliable facts. We have never seen any evidence to satisfy that the direct saving from the burning or prevention of smoke was over five per cent., and in some cases no difference has resulted in the quantity of fuel consumed, whether the smoke was consumed or not. The conditions requisite for combustion are, that the subjects of combustion—the fuel and the oxygen—should be brought in contact and subjected to heat sufficient to unite them. But the smoke discharged from furnaces is generally the result of imperfect combustion consequent upon the stoppage of the process after it has been begun. The stoppage, in many cases, is caused by deficient draught; from want of air the heat necessary for combustion is not maintained. But a common cause of dense volumes of

black smoke is not so much the want of a draught, as the stoppage and combustion of the products of the fuel, nearest to the grate bars, being passed through a layer of fresh fuel and upon the incandescent. By far the greater quantity of smoke is caused by the passing of the heated gases through this layer of cool, fresh fuel, and the better the draught the blacker and more abundant will be the smoke. The means, then, by which the formation of smoke can be prevented, or consumed when formed, are draught, adequate dimensions of boiler, and good management.

Adequate dimensions of the flue or chimney are primarily necessary to prevent or consume smoke. Adequate dimensions of the boiler are not necessary to consume smoke, but to consume it economically and consistently with the performance of the work to be done. Draught is the first requisite, for without it smoke can neither be prevented from burning nor consumed after formation. To many it may appear a very extraordinary thing, that when smoke is burned, less steam is raised in a given time. It seems sound reasoning to say smoke is fuel, and since steam is raised by the burning of fuel, the burning of smoke should raise steam. This is so far correct; but I have observed that in many cases where smoke is consumed by the admission of air above and not through the fuel, there is not so much coal consumed, and since coal is fuel, it is evident that the burning of smoke may, by decreasing the consumption of fuel, lessen the heat of the furnace, and thereby reduce the quantity of water evaporated in a given time. In a steam boiler furnace, if the air be admitted above the fuel, then it is consumed less quickly, and the rate of evaporation is slower; and as the most active part of the boiler is that right over the fire, and for a short distance beyond the bridge, it is evident that any reduction of the heat of that fire will have to be balanced by increased heat in the flues, and whether that will or will not be the case, when smoke is burned, will depend upon the relative constituent parts of the fuel, the setting of the boiler, and the power of the draught. Nothing can be more perplexing and unsatisfactory than the comparative results of experiments made in different places, when the construction and setting of the boiler, with the dimensions of the several parts, are not also given.

A good draught in a furnace is the main element in its economy. I have known a ton of coal saved in a week by adding to the height of the chimney; the sharper the draught the greater is the heat, and the greater the heat the more perfect the combustion, and the more perfect the combustion the greater is the economy, and, with good management, the less the smoke—thus draught is the prime requisite both for economy and for the consumption of smoke.

About twelve years since, a warm controversy was carried on respecting the feeding of furnaces with warm or cold air. Mr. Muir thinks it does not much matter if it be or be not heated before admission into the furnaces; *first*, because, though it is heated, the degree is not very high; and *secondly*, because it is generally heated by the furnace itself, and in that case heating the air is like robbing Peter to pay Paul. When the air is heated, a larger aperture is required for the admission of the required quantity. When the aperture is of the requisite size, it is so much gained if, before entering, the air could receive heat which would otherwise be wasted.

In another communication to the London Society of Arts, Mr. Woodcock maintained that the simplest means of preventing the formation of smoke was by providing for an ample supply of oxygen in a condensed state, in the form of cold air, to the fuel in the fire bars; and by administering such further supply of oxygen to the heated gases as might be necessary for their complete combustion while in contact with the boiler; this latter supply being given at such a temperature as would insure the successive ignition of the gases as they were evolved. Thus, by establishing nearly perfect primary combustion, the quantity of smoke evolved is reduced to a minimum, of which no visible trace ever reached the summit of the chimney.

An apparatus, by which this desirable end was attained, was described to consist of two parts, each being the addition of a very simple apparatus to the ordinary boiler furnace. The first of these was a double set of thin iron bars, lying horizontally in the direction of their length parallel to each other, immediately beneath the grate in the ash-pit. Each set of bars resembled a Venetian blind in its arrangement, the bars being inclined at an angle of 45° to the horizon in the direction of their width. The bars of the two sets were thus inclined in opposite directions, and being so close together that a vertical straight line could not pass between any adjacent pair of them, yet far enough apart to allow all cinders to fall freely through, and the air to pass freely upward to the fire. The bars were of the same length as the grate, so as to extend from front to back. The effect of this arrangement is to screen the ash-pit completely from the heat radiated directly downward from the grate, and so that scarcely any would pass through by reflection. In fact, not a ray of heat could reach the ash-pit from the furnace without suffering four reflections from rough iron surfaces, which would leave a mere shadow of a ray for further progress. Thus a large quantity of heat, which would otherwise be radiated out of the furnace into the ash-pit, thence reflected, and so lost, was saved for the boiler. The ash-pit also was only slightly heated by the cinders which fell through; and this source of heat might be reduced to any extent by frequently removing the rubbish from the pit. Another consequence was, that the air passing from below through the grate, not being heated in the ash-pit, entered the fire cold, and therefore not as it did from ordinary ash-pits in a rarefied condition. By its coolness this air prevented, to some extent, the burning of the grate bars; and, by its unrarefied state, produced a more intense and rapid combustion of the fuel after it had passed the bars.

Another part of the contrivance was more especially the smoke-burning apparatus. It consisted of a set of tubes, open at both ends, passing through the furnace horizontally from front to back, and terminating within the wall of the front of the bridge, with valves to regulate the access of air into the tubes. The fire-bridge differed materially from that of an ordinary furnace. It was hollow, and divided into two parts, the larger of which stood up from below; the other, which was more shallow, was in contact with the boiler. Between them all the products of combustion passed from the furnace. The two parts communicated with each other by channels at the sides, and thus formed together an annular chamber. The tubes before mentioned entered the front wall of this chamber, and thus established a communication between the interior and the outer air. The back wall, or plate, both of the upper and

the lower part of this chamber, or bridge, being perforated with numerous holes, opening from the interior of the bridge to the space beyond it, established a direct communication between the outer air and the throat of the flue. There was a second solid bridge beyond the first, descending from the upper side of the flue; this, by intercepting the direct channel through that part of the passage, retarded the flow of the smoke and gases, and caused their perfect mixture with each other within the space between the bridges. The result of this arrangement was, that a current of highly heated air, which passed through the tubes in the furnace, escaped at the bridge through the perforations in the back wall, and mixing with the gases from the furnace, which held the smoke in suspension, converted the smoke into flame. It was calculated that by the adaptation of this apparatus to marine boilers the high temperature of the boiler-rooms would be obviated, and that the steam vessels would not be so evident from a distance as they now were, by the volumes of smoke they give out.

PULVERIZING MACHINE.

A machine for the pulverization of sugar, gum, and other substances which can not be easily ground without clogging, has recently been invented by Mr. Chase, of Boston.

The machine consists in a novel and ingenious application of stampers affixed to a revolving plate attached to the central shaft, and acting within a circular chamber or mortar. Within this mortar is a circular disk, which occupies the center space, and is furnished with projections or wings on its edge, which divides that part of the mortar nearest its outer edge into a number of rotative cells or chambers. In each of these cells one of the stampers is placed. When the machine is set in motion the stampers and disks are carried round together, and the former are alternately lifted and dropped by means of the gearing and cams placed around the center shaft. Each stamper thus makes eighty beats during a single revolution of the shaft. The cells are fed by the hopper through the spout inserted into the side of the mortar, and, having made one revolution, are emptied through to another hole at the bottom of the mortar into the bolting-sieve placed in the chamber beneath the hopper.

There is one peculiarity in the action of the stampers in this machine which deserves notice: The sides of the cells in which the pounding takes place, being constantly in motion, the material to be pounded is carried round by them, and pushed along or turned over upon the fixed plate which forms the bed of the mortar. By this action a fresh surface is constantly presented to the blow of the stamper, and the ingredients to be pounded never can get beaten into a hard, compact mass, as is often the case with fixed stampers, and thus a very large amount of their power is rendered ineffective.

ARRESTING AND REACTING SPRINGS FOR FIRE-ENGINES.

The following extract from the specification of a patent granted Franklin G. Smith, of Columbus, Tennessee, sufficiently explains the nature of the above-entitled invention:

The design of these springs is to prevent the great waste of power incurred in working the common fire-engine, by causing the descending arm of the working lever (instead of being arrested by some solid part of the machine) to give over all its momentum to springs of such strength as easily to offer the requisite resistance to the blow, and of such elasticity as to give over nearly all of their power to the return-stroke of the engine. In the form commonly seen, every successive stroke of the fire-engine starts from a dead rest, and the power with which the stroke ends is totally lost in giving a blow to the frame of the engine, giving it a very serious concussion, and causing painful shocks to the arms of the firemen. The springs now proposed prevent all jar and concussion from the stroke of the levers, and (supposing the springs to be perfect, that is, to re-act without any loss of power from friction) they convert the entire power with which the stroke is ended, into power acting in the opposite direction for beginning the next stroke. They may be made of any shape and any material so that they will arrest the whole momentum of each stroke, and re-act with energy in starting the succeeding stroke.

ZINC ROOFS.

A square of 100 feet of zinc, at 22 ounces to the foot (No. 14 gauge), weighs, when laid on with laps and rolls, 150 pounds; the same surface in English slates, weighs 830 pounds, and in plain tiles 1,900 pounds. Zinc is, consequently $5\frac{1}{2}$ times lighter than slates, and nearly 14 times lighter than tiles, in addition to the saving of surface and weight, by the flatness and lightness of the framework and supporting walls. As compared with lead, the density of zinc is 7·19, while that of lead is 11·35; the tenacity of zinc is 109·8, and that of lead is 27·7, from whence it follows that while a sheet of zinc of equal thickness to one of lead is only two thirds the weight, its strength or sustaining power is four times that of lead, while the cost is proportionately low as applied to each material.

IMPROVED CAST-IRON PAVEMENT.

A new form of cast-iron pavement has recently been laid down in Philadelphia for experimental purposes. It consists of cast-iron plates, 12 feet long, 3 feet 4 inches wide, and $\frac{5}{8}$ inch thick; 12 feet being the width of the pavement to the curb. These plates are roughened on the surface by grooves, $1\frac{1}{4}$ inch apart, crossing each other at an oblique angle, so as to divide the surface into diamonds. A cast-iron half-inch plate, with its two edges turned at a right angle, so as to make flanges at the top and bottom, forming a girder 11 inches deep, is bolted to the columns of the building, making a support on which the inner ends of the plates rest. The curb is of cast-iron, $\frac{1}{2}$ inch thick, 11 inches deep, having a flange each side, at the bottom, and on the inside only at the top; it is made to slope slightly outward from the top to the bottom. This curb rests upon a brick wall, forming the outside wall of the cellar, a good cement being interposed to make a water-tight joint; the pieces of curb have butt joints secured by a cast plate behind, riveted securely to

both pieces, cement being interposed. From the building girder to the curb, and resting on the lower flange of each, stretch-girders or joists, 12 feet long and 11 inches deep, 3 feet 4 inches apart, on which the pavement plates are laid and securely fastened by bolts or rivets, with counter-sunk heads, going through the flanges of the girder, the joists, and the curb. All the joints are carefully cemented so as to be water-tight; the transverse girders or joists are of half-inch cast-iron, strengthened on the bottom flange by wrought-iron flat bars, bolted to the cast-iron only at the two ends, and slightly expanded by heating when it is put on, so as to bring the lower part of the girder into a state of compression.

IMPROVEMENTS IN CARRIAGES.

Mr. Michael Scott of England, has recently brought before the public a three wheeled carriage designed for affording superior facility of motion, with ease and accommodation to the occupants, and means of resisting the wear and tear of traffic. It has two wheels behind, and a single central wheel in front, as high or even higher than the hind pair. This lightens the draught and simplifies the under frame-work. The driver's seat occupies the place usually assigned to the rumble, directly over the hind wheels, so that the reins stretch over the body of the carriage.

Glass and Iron Axle-boxes.—An invention has recently been brought out by Mr. Campbell of Columbus, Ohio, for constructing cast iron axle-boxes with a lining of glass on the interior. It is claimed that there is less friction in these boxes, with less lubrication than in any other.

Wilson's Improvement.—In common lumber wagons the ends of the reaches overlap, and are secured together by means of a pin; in order to render the length of the reaches changeable, their ends are bored with holes, placed at different distances, through which the pin passes. Reaches thus bored and fastened are weak, and frequently break down. An improvement patented by Edward Wilson, of Prattsburg, N. J., consists in placing a series of rack teeth on the ends of each reach, so arranged that the teeth of one rack fit into those of the other; when the two racks are united a sliding ring collar is employed to hold them together. In order to change the length of reaches, it is simply requisite to loosen the collar, set the racks as desired, and bind them again with the collar. Reaches thus furnished are not bored, and are, therefore, much stronger; the coupling is also much more rigid than the old plan.—*Scientific American.*

Green's Patent Sleeve-Axle.—Mechanical journals, the records of the Patent Office, and the heads of inventors, seem to be about equally full of car axles, car axle-boxes, etc.; and the good old "go-cart," with its more refined developments of barouche and buggy, seems to be left somewhat in the shade. Occasionally, however, a step is taken in this direction, and the Sleeve-axle, although some two years before the public, may be one of those not yet sufficiently known. The old English mail-coach patent dispensed with both linch-pins and nuts at the end of the axle by placing the fastening on the inner instead of outer side of the wheel. A high thin collar was turned on

the axle just at the inner edge of the bearing, and a ring of thin metal was bolted to the inside of the limb in such a manner as to take hold of this collar and prevent the slipping of the wheel endwise. This allows the end of the hub to be boxed completely in, keeping out the dirt and preventing the possible appearance of grease and filth at these prominent points on an elegant carriage. Green's Sleeve-Axle is simply an improvement on this "mail-coach" style, and has the effect of making the axle last longer—in fact, last forever, in theory, as the wear is entirely removed. The collar and the whole bearing surface of the axle are made in a separate piece or sleeve, and fitted tightly on over the true axle. The true axle is wrought iron, and forged octagonally and tapering at the extremities. The sleeve is of cast iron, and when worn a little on one side, may be removed and turned one eighth around, in as many hours as it required days to repair the solid axle. When all eight of its sides are sufficiently worn, the sleeve has only to be rejected, and a new one supplied. The patentee is E. H. Green of Baltimore.

IMPROVED CYLINDERS FOR CALICO PRINTING.

In printing fabrics by the ordinary system, the copper rollers employed are found to be easily affected by the chemical action of the mordants, colors, and other matters employed in calico printing; and great expense is occasioned by the large outlay necessary for the production of the engraved metallic rollers, which are not only very costly, but from the reasons above-named, are far from being durable. It is proposed to obviate these disadvantages, by employing cylinders covered with india-rubber or gutta-percha, which materials are afterward vulcanized and rendered extremely hard. Thus prepared, they are engraved in the same manner as ordinary copper printing cylinders or rollers, whether in *intaglio* or relief. Such printing surfaces are produced with facility and economy, while their printing action is sharp and effective, and not subject to injury from the action of acids, alkalies and other agents employed.

IMPROVED MACHINERY FOR PICKING FIBROUS SUBSTANCES.

In machines for picking cotton and other fibrous materials, the picking cylinder is generally covered with what is termed a "fillet;" this consists of a sheet of leather filled with ordinary card-teeth. The heavy work at which pickers are employed requires that the teeth should be very firmly secured—else they break, bend or otherwise refuse to do good work. A recent improvement by Mr. Kitson of Lowell, consists in making the teeth separate, and in attaching them, without any fillet to the cylinder. His mode of attachment is such that they may be made larger and stronger, with corresponding advantages in durability, economy and thoroughness of operation.

IMPROVEMENTS IN LOOMS AND WEAVING.

Broadbent's Improved Loom.—The principal feature of this invention by John Broadbent, of Oak Grove, Kentucky, consists in the employment of two

hooks instead of a shuttle for putting the filling into the warp, which enter the sheds from opposite sides, the one to take the filling thread from a bobbin or one of a series of bobbins conveniently placed on the side of the loom, and carry it half way through the shed, where it is met by the other hook, which takes the thread and retreats, thus drawing the filling entirely through. The filling thus drawn through is double, but the threads are laid evenly side by side, without the possibility of twisting, so that the texture and appearance of the goods remain precisely the same as if the shuttle were employed. All the other points of the invention are more or less subservient to this principal feature. The invention is applicable to nearly all kinds of hand or power looms, either for plain, fancy or figured goods, as well as wide or narrow carpets. Among the advantages which the hooks possess over the shuttle, are first, in running lighter, and consequently requiring less power. Second, in being less subject to wear and tear—the shuttle motion and its appendages being the most expensive part of a loom to keep in order. Third, in obviating the damage likely to occur by the shuttle flying from the loom. Fourth, in seldom requiring the stoppage of the loom, an accident which is not very liable to occur. As there are no shuttles to be filled, the loom would not be required to stop for a whole day, since the bobbin can be renewed at any moment without stopping.

Mr. William Talbot, of Willimantic, Connecticut, has recently made some valuable improvements on the loom, adapted to facilitate and perfect the weaving of bags, diapers, twills, checks, and cassimeres. The primary idea of the loom is that of the Jacquard and the endless chain modified and compacted. The improvement can be so arranged, in a very short period of time, as to weave bags, twilled or plain, of exactly uniform length, or of exactly an equal number of picks, day after day, or rather through beam after beam, making a real and strong bottom to each. The cards of the Jacquard and the endless chain are dispensed with by Mr. Talbot, in weaving large patterns. Their places are supplied by two cylinders, the rotary action of one being used in making the body of the bag, and the action of the other being used in making the bottom of the same—the action of the one cylinder giving motion to the other cylinder when the first is desired to be motionless, and the second is desired to be in action. Another fact about the loom is, that it weaves with a *shed opening both ways;* not a peculiarity indeed, but a fact which every manufacturer of goods, figured in weaving, may desire to know. We have seen a loom in operation having seventeen harnesses, and the shed was broad open, for the free and easy passage of the shuttle, without any great tension of the warp. The open shed, moreover, is connected with such a particular motion of the harnesses, that when any one or more are either up or down, they have a pause in their motion; a short pause, indeed, but still of great value in giving time for the shuttle to race through its course. In most looms, when a harness attains its greatest height in weaving, or its lowest point, it is made *instantly* to move to the opposite point. This improvement, on the contrary, gives the harness a moment's pause when it is either up or down in its motions. Connected with this fact of a pause in the motions of the harnesses, while they are at the highest or lowest point, is this

other fact, that this improvement secures such a *compensation* of *motion*, as to require but a moiety more power to run it than is needed in the lighter and plainer looms. One or more harnesses up-balance an equal number which are down; and very little power is needed to make them change places, so perfectly is compensation secured. This peculiarity stands connected with another, which is, that the loom, while moved with little power and noise, can safely and properly be made to move with very great speed. We have seen it going at the speed of 130 picks to the minute, and we know that it can be tended with the ease of the common loom.—*Plow, Loom, and Anvil.*

Weaving Looms.—A patent has been granted to James Ballough, Eng., for preventing broken warp threads becoming entangled in the shed of a loom. He employs an extra leaf of *healds* placed behind the ordinary harness, and gives to this leaf a motion backward and forward between the yarn, making them act like a comb to throw back any ends of broken yarn from being carried forward to obstruct the proper shedding of the warp.

Improved Shuttles.—Two patents for improvements in shuttles have recently been granted, one to E. P. Marble, of New Worcester, Mass., and the other to Laroy Litchfield of Southbridge, Mass. The two are entirely dissimilar in character, although they relate to the same instrument—the simple shuttle.

The patent of Mr. Litchfield embraces a novel method of applying a spring to keep the shuttle-cop in place, and which admits of the repeated raising and replacing of the spindle to renew the yarn, without causing such wear as to throw the spindle out of place. It also embraces a regulating screw, to bring the spindle at once to a proper position in the shuttle. A spring catch is also employed in such a manner as to confine the bobbin (when one is used), so that without changing the position of the spindle, or rendering it unsteady, a large or small bobbin may be secured to the shuttle.

The invention of Mr. Marble relates to an improved mode of applying the spring catch that is employed to confine the bobbin in shuttles, by which it adapts itself to varying sizes of the heads of the bobbins, and whereby it is drawn square off the bobbin heads with the spindle, so as not to drag upon and split the heads—a fault common to shuttles now in use. The improvement also enables the catch to be conveniently applied to the cop-shuttle, to confine the tube of the cop, or the cop itself if spun without a tin tube. The catch to confine the cop is made with a small notch to receive the collar of the tin tube, and it has a point to catch and confine the cops which are made with paper tubes.—*Scientific American.*

Pickers for Power-looms.—Thomas Holliwell and Joseph Barker, of York, Eng., manufacturers, have taken out a patent for preserving pickers and picker-sticks, and for preventing caps coming off the shuttle during the process of weaving. The invention consists in the use of a spring of steel or whalebone fixed behind the back end of the shuttle-box, such spring being attached at one end to a raw hide, and it has a hole in the other end passing around the sirspindle of the shuttle-box. The raw hide forms a buffer bringing the shuttle gradually to a state of rest, and preventing it going too far into the box, and it also assists in returning it for the next shot.

NEW PROCESS FOR MAKING PAPER FROM STRAW.

The following notice of a new process for manufacturing paper from straw and other vegetable substance, by M. Helin, of Belgium, is taken from the London *Practical Mechanics' Journal*:—

The increasing scarcity of materials for making a cheap and serviceable paper, has been often brought to the attention of our readers; and other portions of the public press have not been backward in stimulating the energies of the inventive and mercantile classes to increase our supplies or cheapen the manufacture. A thousand denizens of the vegetable kingdom can, under appropriate treatment, be made to assume the form of paper. We are continually hearing of some enterprising individual having converted a very unlikely material into a useable paper. But when we inquire into the particulars of the manufacture, we soon find that the cost exceeds the value of the product, and that, in place of having a cheaper article, the paper thus produced could not be sold at so low price as that previously in the market. Again, we are frequently receiving intelligence of the vast quantity of raw material which the tropics can supply. We make no doubt that such representations are perfectly correct; but against the abundance of supply has to be set either the expense of either getting rid of extraneous matter, in a country where there is no machinery, or the expense of a long carriage by land and sea of a very bulky article. In either case the cost will not allow the paper to be brought into competition with that now manufactured. One of the materials which earliest suggest themselves as suitable for conversion into paper, is the straw of grain-bearing plants. An abundant supply of this material can be obtained at a cheap rate. There is a difficulty however in the manufacture, which one might easily overlook until the experiment is made. Straw contains a good deal of silica, principally in its exterior coating, and it is necessary to get rid of this before it can be made into paper. Now, the cost of the process is considerable, and has been hitherto found so great as to render the manufacture unremunerative. The principal object of M. Helin's patented process, to which we will now draw the reader's attention, is to reduce the expense of the desilicatization of the straw, and thus to add, in a very important degree, to the supply of our paper-yielding materials.

M. Helin's invention relates to a peculiar treatment of the straw of grain-bearing plants, for producing a pulp suitable for the manufacture of paper at an economical rate. For this purpose it is preferred to employ the straw of rye and wheat, but the same mode of treatment is equally applicable to various other vegetable substances, such as jute, flax, and hemp. The straw is first steeped entire for 60 hours, which time may be exceeded without inconvenience, in spring, rain, or river water, of a temperature of from 55° to 85° Fahrenheit, the temperature being varied according to the season of the year. After some hours, the water becomes gradually warm and discolored, and an active fermentation takes place. After 60 hours the liquid is suffered to run off, and the straw must be washed with a plentiful supply of water, in order to remove therefrom all the soluble coloring matter. The straw is then

drained, and while still damp is subjected to the action of millstones, rolling on a plane surface, or passed between a pair of rollers, in order to flatten the straw. It is then forced between other rollers furnished with cutters, or other suitable apparatus, whereby the straw may be formed into filaments or fibers, as long and continuous as possible. In this state, that is, when reduced to long and continuous filaments, the straw is to be exposed to the air and sun, for the purpose of drying it, after which process the straw will have assumed a pale yellow color. In cases where time is no object, it is preferred to steep the straw several times, and again expose it to the air and light. It will be found convenient, in such cases, to steep the straw at night, and expose it to the air during the day, to obtain the full benefit of the air and light. The first described process of maceration is, however, the most important. By subjecting the straw to the action of water, and subsequently exposing it to the air and light, it becomes bleached to a certain extent; but by means of the process described below, it is completely divested of all coloring matter, and is rendered perfectly white. After having been submitted to the processes referred to, the straw is steeped for one or more days, according as it is in a more or less filamentous state, in one or more of the preparations afterward described, the filaments being first treated either with the alkaline solutions, or by the solutions of hypochloride of potash or soda; and sometimes, for a longer or shorter period, with the preparations of hypochloride of lime, until the straw has acquired the requisite degree of whiteness. The filamentous straw, after it has been submitted to the processes first described, and has been steeped in the alkaline solutions of soda or potash, which take up a great portion of its yellow coloring matter, assumes a darker tint, notwithstanding its being washed in clean water. This darker tint disappears, however, on the straw being exposed to the open air and light; and the process, if renewed, causes the straw to become more and more white. By these processes the straw becomes reduced to beautiful filaments, which may readily be converted into pulp; and from their solidity and strength, the filaments might even be employed in the manufacture of yarns or fabrics similar to cotton and hemp. Jute and many plants of Linnæus' order, Triandria, in which are comprised the various grasses, and many plants of the orders Tetrandria, Pentandria, Hexandria, and Diœcia, when treated by the processes herein set forth, lose their coloring principles, and become of a permanently bright white. Hemp and flax may also be thus treated, and employed in the manufacture of paper.

The solutions or preparations above referred to, consist, first, of a solution of 8 lbs. of carbonate of soda or of potash, in 20 gallons of water; second, a solution of 6 lbs. of bicarbonate of soda or potash, in 20 gallons of water; third, a solution of 4 lbs. of caustic potash or soda, in 20 gallons of water; fourth, a solution of 10 lbs. of hypochlorate of potash or of soda, in 20 gallons of water; fifth, a solution of 1½ lb. of hypochlorite of lime or bleaching powder, in 20 gallons of water, to which may be added, in addition, if necessary, 1¼ lb. of bleaching powder; sixth, a solution of 6 lbs. of bleaching powder, or hypochloride of lime, in 20 gallons of water; seventh, a solution of 6 lbs. of bleaching-powder, and 2 lbs. carbonate soda or potash, in 20 gallons of water

After the maceration in water, the subsequent treatment of the straw, by any of the before-mentioned processes, may be thus enumerated:—1st. By alkaline solutions. 2d. By solutions of hypochlorides of soda or of potash. 3d. By the employment of the hypochlorides of lime, potash, or soda, as described in processes 6 and 7. When the alkaline liquids and the hypochlorides, contained in the preparations 1, 2, 3, 4, and 5, are too much charged with coloring matter, by reason of the repeated immersions of the straw, they are filtered through a layer of animal charcoal, reduced to a granulated or powdered state, for the purpose of obtaining a partial or total discharge of the coloring matter therefrom. The hypochlorides of soda and potash decompose after they have been long in use, but they may be renewed from time to time by chlorine gas, or by a solution of chloride of lime. The straw or vegetable filaments are well washed with water, after they have been perfectly bleached by the above processes, or some of them, and may then be made into pulp in the ordinary manner, for the fabrication of paper. It is evident that hydrochloric or sulphuric acids may, if deemed necessary, be used in connection with the above bleaching materials, as is now well understood and generally adopted in the bleaching of pulp in the manufacture of paper.

MANUFACTURE OF BANK-NOTE PAPER.

From the Report of the Committee of the New England Association of Banks for the Suppression of Counterfeiting, appointed to report upon the specimens of bank-note paper which were offered for the premium of $100, we glean some interesting particulars, relative to the strength of bank-note paper. Two of the most extensive bank-note paper manufacturers offered specimens, and the premium was awarded to J. M. Wilcox & Co., Ivy Mills, Penn. These papers were tested by Charles T. Carney of Lowell. Sheets were drawn at random from 500 sheets of each specimen, and their strength tested both lengthwise or by perpendicular strain, and crosswise or by transverse strain, also with and without sizing. The first experiment was with paper made by Crane & Co., weighing 14 lbs. to the ream. The first sheets used were each halved and weighed, each half sheet being folded double when tested. A half sheet weighing 3·165 grammes, having 64·81 square inches to support the strain, stood a perpendicular strain of 20·5 lbs. Without sizing and weighing by its loss 3·070 grammes, it stood a strain of 100·5 lbs. For a transverse strain, a half sheet weighing 3·227 grammes, with 53·375 square inches stood a strain of 254·5 lbs. Without sizing, and weighing 3·085 grammes, it stood the strain of 146·5 lbs.

For the second experiment, paper made by Wilcox & Co., 14 lbs to the ream, was used. A half sheet as before, weighing 3·505 grammes, and offering 61 square inches to the strain, stood the strain of 120·5 lbs. Transverse, a half sheet weighing 3·180 grammes, with 53·375 square inches, stood a strain of 260·5 lbs. Without sizing and weighing 2·830 grammes, 105·5 lbs. Experiment No. 3, was with paper made by Wilcox & Co., weighing 16 lbs. to the ream. A half sheet weighing 45·86 grammes, with 61 square inches, stood a strain of 300·5 lbs. Without sizing and weighing 4·520 grammes, it stood a strain of 137·5 lbs.

The average results of Crane's paper, 14 lbs. to the ream, with sizing, was an average perpendicular strain of 3·35 lbs to the square inch, with an average of 3·151 grammes; and an average transverse strain of 4·75 lbs. to the square inch, with an average of 3·134 grammes weight. Wilcox & Co.'s, with sizing, 14 lbs. to the ream, stood an average perpendicular strain of 3·66 lbs. to the square inch, the average weight being 3·195 grammes; and a transverse strain of 4·81 lbs., with 2·991 grammes weight.

MANUFACTURE OF BANK-NOTES.

At a recent meeting of the Society of Arts, London, Alfred Smee, F.R.S., and chemist of the Bank of England, read a paper and unfolded publicly the improved method employed by that great institution for manufacturing the bank-notes, to prevent forgery by the substitution of surface printing on the notes, for line printing.

The notes and checks of the Bank of England have, up to the present time, been invariably printed from copper and steel plates, in which the lines were engraved, or cut into the metal, and into these lines was introduced the ink, which in the progress of printing was transferred from the plate to the paper. In surface printing the reverse of this state of things occurs, as the design, instead of being cut into the metallic plate, is raised in relief, and the ink being applied to the raised portions by means of rollers, is transferred by the press to the paper in order to produce the impression. A single cut with a graving tool forms the groove which holds the ink in plate printing, while for surface printing a line must be cut on both sides, and equally finished on both, thus materially increasing the difficulty of engraving. From a steel die electro moulds were obtained, and electro copper produced by this system is found to have hardly any limit to its durability. The limit to the duration of the electro casts, for the purposes of bank-notes, has yet to be ascertained, as almost a million of copies have been already printed from one without any sensible effect. The platinized silver voltaic battery is the one used by the bank as a source of power, and its successful operation was exhibited to the meeting. It was devised by Mr. Smee, who received for it a gold medal from the Society, and it has stood for 14 years the test of experience. At the bank large batteries are employed, holding several gallons of the acid charge, the platinized silver plate being of fair thickness, and the thick rolled zinc plates being so arranged that they can be easily changed. For charging the battery dilute sulphuric acid is used, generally mixed in the proportion of $\frac{1}{8}$ acid to $\frac{7}{8}$ of water. In order to secure a strength suitable to the purposes of the battery, it is convenient to adjust the mixture to a specific gravity of 1130, and a battery so charged will continue in action nearly three weeks before it will be completely exhausted. It is found, however, in practice, that after having done efficient duty for from 7 to 14 days it becomes feeble, and requires a fresh supply to resuscitate its former vigor. A hygrometer is generally used to ascertain the changes, but Mr. Smee described an instrument constructed by himself for the purpose, which he termed a battery meter. The point corresponding to specific gravity 1.130 is called unity, the interval between that

and 1.160, the density of the exhausted battery, is divided into 144 parts, by which division every degree represents 1 grain of zinc dissolved in 1000 grains of bulk of fluid. The opposite side of the scale between the same points is divided into 60 parts, each of which is for every grain of bulk in the fluid, about $\frac{1}{1000}$ of an inch in thickness, for every superficial inch of surface upon which the copper is reduced in the precipitating trough. In this division a little allowance has been made for some local action of the zinc, and by this instrument the quantity of that metal which has entered into combination with the oxygen of the water in which it is subsequently dissolved, is really weighed. In the application of the battery meter we have an illustration of a law which governs all physical phenomena, that without a change of matter we can not have any physical force; for in the electro-metallurgic apparatus we have an effect equal to the original change of matter within a trifling per centage. Thus by the use of the battery-meter, this great law is popularized, furnishing a remarkable illustration of the reference of effect to cause. To contain the battery with its charge the best salt-glazed stone-ware is employed, although no form of earthenware has been yet found permanently to resist the attacks of the metallic saline solution, but being less brittle, it is still preferable to glass.

The best standard salt for the reduction of copper by electro-metallurgy has been hitherto the sulphate, and, with the occasional exception of the nitrate, is invariably employed. On procuring suitable originals, with proper means of duplication, the next process is to obtain perfect models, gutta percha blackleaded is generally employed. When perfection is desired, electro moulds, and electro moulds alone, are relied on, for which purpose the original is placed in the depositing trough, and a thick electro mould deposited. The casts are generally deposited so thick in the compound trough that they can be turned down to the required form and size, and all depositions in electro moulds require for the highest perfection the utmost care, and the casts when ready for printing are mounted on solid brass blocks.

MACHINE FOR MAKING TREE-NAILS.

The business of making locust tree-nails is an important branch of American industry. Tree-nail is the technical name of a long pin with which the planks of a ship are fastened to the timbers. It is believed by those well acquainted with the business that the best timber in the world for tree-nails is the locust of Long Island. This is an American tree. It has been introduced into Europe, and in some situations produces excellent timber, while in others it is pronounced worthless. The true variety grows large enough for ship timber, and it has a great tendency to sprout from the roots after the original stalk has been cut away, thus reproducing itself continually. It is the timber of these sprouts, when some six or eight inches diameter and ten to twenty years of age, that is mostly used for the manufacture of tree-nails.

Tree-nails are usually made by sawing the timber into suitable lengths while in a green state, and splitting up the bolts with a frow. The sticks are then shaved octagonally, and this requires nice work, as they must be very true

and with but little taper, so to fit the hole, often sixteen inches deep, as tight at the bottom as upon the outside.

As the wood is hard and stringy, it is not an easy matter to make all the pins equally good, even by the most skillful workmen; and by those that are careless they are frequently made so tapering that one half of a lot are frequently found to be worthless, the butts only filling the hole, and being wedge-shaped, very apt to check the plank.

To obviate these difficulties the common turning-lathe has been employed, and large quantities of round tree-nails have been used. The lathe made them true, and timber could be worked by that means that could not be shaved by hand; but there was another difficulty that could not be overcome —the tree-nails made in the lathe were round, and could not, like the eight square ones, be driven into a hole actually smaller than the diameter of the pin, and when forced in by the hardest driving the round pins could be driven out. It is a consideration of the most important kind, that, when driven home, the tree-nail should be absolutely immovable, as many a ship has been lost by "starting a butt;" that is, drawing the fastening. A well made eight square tree-nail being the one thing needed in ship-building more than any other, a machine that would do the work in a rapid, economical manner, both of time and timber, it was thought by ship-builders would be one of the most important mechanical inventions of the age. Most of those who thought upon the subject said the thing was impossible. A man by the name of Fitzgerald, of New York (since deceased), by nature an inventor, being told what was wanted, said at once, It can be done, and at once set himself to work and completed a machine, which is now in successful operation.

The machine is about 4 feet long and 3 feet high, iron frame, the cutters eight in number, driven by a band and pulley. The stick in its rough square form is held up to the cutters a moment, and then is taken into the feed wheels, which carry it forward, each cutter revolving and cutting one of the eight sides, the taper, or variation in size, being so regulated by a cam, that the tree-nail may be cut with a true taper from end to end, or made smallest in the middle. It is found best to run them through two machines, the first shaping, and the second finishing, at the rate of about 430 feet an hour. The length varies from 16 to 24 inches, and size from $\frac{3}{4}$ to $1\frac{1}{2}$ inches diameter. Whatever the size or shape, whether tapering or straight, the cam being set for the particular size desired, every one must inevitably be of the same exact form, and such is their perfection, that one has never been known to check a plank, and they can be driven into holes a sixteenth of an inch less than the pin, the eight corners pressing into the wood, and making a water-tight joint at the extreme end. It is found, too, that they drive extremely easy, and that it is absolutely impossible to start one of them back.

MACHINE FOR QUARRYING SLATE.

Slate has heretofore been all cut out in quarries by hand labor. The workmen with picks cut grooves in the rock to the depth required, and then the slate comes off in thin layers the size of the space between the cut grooves,

forming rectangular slabs. To supersede this slow method of quarrying slate, H. J. Bremner, of Nazareth, Pa., has invented a machine, in which cutters are operated so as to feed forward and cut out a groove in one direction, the desired length, and then it (the machine) is turned, and the cutters made to cut a transverse groove, and thus proceed until the rock is so grooved that the space between the side and two end grooves or cut channels, forms a slab of the size desired for the slate; the slate is then forced out, and splits easily into as many separate slabs as there have been horizontal layers from the surface to the depth the cutters have perforated. One of these machines, it is asserted, when operated by hand, and with one man, will cut out more slate in one day than twelve men with picks by hand labor.

Machine for Cutting and Trimming Slate.—A machine for cutting and trimming slate has been invented and patented by Asa Keyes, of Brattleboro', Vermont. The nature of the invention consists in applying a rapid succession of stone hammer blows, each of which beats off a minute piece of the slate while it (the slate) is carried along by a carriage on ways. The wheel which carries the hammers or cutters is heavy, and this weight of the wheel not only furnishes the momentum of the individual blows of each hammer, but supplies the purpose of a fly-wheel to the machine. The hammers are held into mortises cast in the wheel, by bolts and nuts. Fifteen of these machines are used by the New England Mining and Quarrying Company, at Guilford, Vermont. They have greatly reduced the cost in trimming and cutting of slate. A detailed description of this machine, with diagrams, may be found in the *Scientific American*, February, 1853.

HYDRAULIC ROCK DRILL.

In this invention by Mr. J. Echols, of Georgia, the drill-rod is provided with two cup-shaped collars, the hollow sides facing toward each other. A line of hose leads from an elevated reservoir and throws a stream first upward against the upper cup, then downward against the lower one. The force of the water thus applied keeps the drill continually leaping with great force; and considerable ingenuity is displayed in working out the details so as to secure the fullest effect of the water, properly rotate the drill, and make the position of the cups and of all the parts self-adjusting as the drill penetrates into the rock. The simplicity, lightness, and portability of this machine constitute its chief advantages, and these are so important as to make practicable the employment of this drill, even where a steam-pump must be employed to impel the water. There is a loss of effect in the transmission of power in this manner, similar in kind to that of using water by an undershot or a turbine wheel; but, rightly managed, this loss may be reduced to a very small percentage, and the difference between the stretching a hose across a ledge, and the arranging of cumbrous machinery with belting or shafting, is sufficiently great to atone for many inconveniences.

IMPROVEMENT IN BLASTING ROCKS.

An improvement in blasting rocks, recently patented by Capt. C. F. Brown, of Warren, R. I., consists in placing the powder or charge within a tube or

case, between two heads provided with suitable packing, and attached to a rod, by which arrangement the charge is prevented from "blowing out," or obtaining vent in the direction of the line of the hole in which the tube and charge are placed, and the whole effect of the charge is exerted against the sides of the tube or case.

By this method rocks may be blasted with much greater facility than by the ordinary mode, no tampering or packing of clay being necessary to confine the powder within the hole. The implement may be used repeatedly, as it can not be projected to any great distance from the spot where used.

The *Northern Star*, of Warren, R. I., contains a notice of the operation of this improvement witnessed by five persons, by which one pound of powder moved one hundred tons of rock.

BROWN'S PATENT SOUNDING INSTRUMENT.

This invention by Captain C. F. Brown of Warren, R. I., relates to a new and useful instrument for sounding the ocean depths, and consists in attaching to a spindle a long spheroidal chamber, containing some gunpowder within the lower part, and having underneath the chamber a needle operated by a spring, which is forced against a percussion cap on a nipple, and thereby igniting the charge of powder when the lower end of the spindle strikes the bottom; and the time that elapses from the period the instrument is dropped until the sound is heard, or concussion felt, is noted, and the depth determined upon positive data to form proper conclusions. The sound of the explosion will be heard or the concussion will be felt, at the surface of the ocean, by those who have let down the instrument, and the time which elapses between letting it fall and hearing the sound of the explosion must be ascertained by a stop-watch. By this means the depth of the ocean may be ascertained, for a table may be formed from a number of recorded experiments giving the time between the dropping of the instrument, and that when the sound is heard at the surface, according to ascertained depths. A percussion cap can be used on the nipple, or a pill of an alloy of potassium. Water is required to ignite the latter, and for this purpose small apertures are left at the upper part of the tube, to be opened when the instrument strikes the bottom.

This instrument is a simple means for sounding the depth of old ocean, and also for ascertaining the strength and direction of a current, for if it appears that the ocean is agitated at a spot on the surface distant from where the instrument was dropped, it will afford evidence of a current, and its velocity—according to that distance.—*Scientific American.*

IMPROVED COAL-HOLE COVER.

Mr. F. H. Moore of Boston, has recently patented a rather singular improvement on the covers of the ordinary coal-hole in our sidewalks, designed to prevent the possibility of accidents, either from children falling through them when left open for a few minutes or from pedestrians stumbling over them when loosely fixed. Moore's cover is not exactly removable and only

to a limited degree liftable. The upper surface resembles the ones now in general use, but its under surface is armed with three vertical rods which descend through ears in the sides of the seat. The cover is provided with a ring let into its top to form a convenient handle, and the hole is opened by raising the cover bodily to a height of about three feet, in which position it is sustained by a catch or a spring, and the coal or wood is to be thrust in sidewise between the three rods. The coal-hole, when open, resembles a half-constructed parrot-cage, an embellishment which may not be considered particularly ornamental in front of a city mansion, but is decidedly more so than the very undesirable pits and foot-traps now exhibited.

IMPROVEMENTS IN AMALGAMATORS.

An improved amalgamator patented by Samuel Gardiner, Jr., of New York, consists of one or more pairs of metallic rollers geared together and revolving in a trough in contact with mercury. The journals of the rollers are hollow, and so are the rollers themselves; the latter are perforated with fine holes, so that, by the introduction of water through the journals, there will be an unceasing outward discharge of water on the surface of the rollers, keeping them continually moist. The quartz previously pulverized and mixed with water into a thin paste, is introduced from above upon the rollers, and by them spread over their entire surfaces; the rollers coat themselves, as they revolve, with mercury, and the latter absorbs the gold dust from the paste. The issuing water from the rollers loosens the quartz as fast as it forms upon their surfaces, and the gold, being heaviest, falls to the bottom of the trough. A running stream of water constantly flowing into the trough carries away the quartz dust, and the rollers come round with a fresh coating of mercury at every turn.

PRESSURE STOPPER FOR CHAIN CABLES.

This improvement by James Emerson of Worcester, Mass., consists in a means of preventing the injurious effects resulting from the sudden jerking of the anchor chain, when a vessel is riding at her moorings. In rough weather and a heavy sea, the windlass is liable to be injured, and the chain to be snapped, from the cause above-mentioned. Mr. Emerson makes use of a stopper, one portion thereof consisting of a sliding weight under which the chain passes. The weight is pressed down upon the chain by means of a lever, so that the degree of pressure may be very easily regulated. When the force of the jerk exceeds the pressure of the stopper, the chain will slip a little, and so afford the required relief.

WHAT IS A LANCASTER GUN?

The invention of Mr. Lancaster relates wholly to the contour of the gun's bore, which is a modification of the common rifle bore. Instead of cutting twisted or helical rectangular grooves in the bored surface, as in all ordinarily rifled arms, Mr. Lancaster forms his bore in the shape of a twisted

ellipse, or, as it may be otherwise termed, an elliptical twist. No drawing can well give a fair illustration of the peculiarity involved in this form of bore. A knowledge of its essential features may, perhaps, be best obtained by the reader, by the aid of a roll or tube of paper. Let him for instance, roll up a sheet of paper, in the form of a plain cylinder, then applying slight lateral pressure to the yielding tube, he will give it an elliptical transverse section. Still holding the tube in this condition, a slight twist must be given to it round the axial line of the bore as a center. This, then, is the "Lancaster" bore, amounting to a two-grooved rifle with very wide grooves. The diametrical measurement across the transverse axis of the ellipse coincides with that line which in the common rifle would be comprehended between the bottoms of two opposite grooves; while a line taken across the conjugate axis, answers to the measurement of the plain surface bore of the ordinary arm. Hence there are no angularities in this bore; what are, in reality, the rifle-grooves, are formed so as to sweep gradually and smoothly by a symmetrical curvature into the projecting or plain surface of the bore. The great object here carried out is the getting rid of all angles in the bore, and the ellipse is the most convenient form for attaining this result, although it is obvious that many other sections of bore might be used for a similar purpose. Any of the common forms of balls may be used in cannon of this class, provided the sectional figure corresponds in its bearing part to the ellipse of the barrel, the cylindro-conoid being clearly the best suited for this, as for smooth bores, or common rifles. Mr. Lancaster has also adopted a new form of percussion explosive action, for use in his guns. He uses a piece of copper tube, surrounded at its lower end with leather, molded to fit the fire-aperture of the breach. The lower portion of this tube is filled with gunpowder, while the external upper part is supplied with a detonating compound. On the barrel, or plug, of the gun, is a projecting piece, standing somewhat below the uncovered portion of the detonating tube, so that when the hammer strikes the tube the projecting stop offers a resistance to the blow, and causes an explosion of the detonating substance. Many of the Lancaster guns used in the Crimea have burst in a most destructive way; whether there is too little metal in the guns for their charge and weight of ball, or whether the great tendency of the ball to go straight forward, and thus wedge itself in attempting to over-ride the very gradual curve of the rifled bore, is not yet a settled point.—*Lond. Prac. Mechanic's Journal.*

Notwithstanding their immense range, the Lancaster guns have been found in the Crimea to have little precision in their aim, and to be enormously expensive, each charge costing £20 ($100).

IMPROVEMENTS IN THE FABRICATION OF ARMS AT THE UNITED STATES ARMORIES.

Within the last few years, the superiority of the rifle barrel has been made greatly manifest. It has also been so modified and improved as to adapt it to the use of infantry arms. The improvements concentrated in the "Minié" invention have abundantly illustrated these facts; and seizing upon them as

a basis, the ordnance department of the U. S. army have instituted experiments, that have resulted in the establishment of a new model for the U. S. musket, which contains all the advantages of the Minié rifle, and others first united in itself. At the U. S. armory at Springfield, the manufacture of the "rifle musket" has been commenced to the entire exclusion of the old "gun musket." The new arm differs from the old one in the following particulars: A change from the smooth bore to the rifle. The length of the barrel is reduced from 42 to 40 inches. The exterior reduced and the caliber from 0.69 to 0.58 of an inch. The barrel to have three decreasing grooves, with a front and rear sight brazed on, graduated from one to one thousand yards. The bayonet, ramrod, mountings, and stock, are much improved from the old model, and the weight of the new arm completed is about 9¾ pounds, which is one quarter of a pound lighter than the old model. The lock is changed to a front action swivel lock with the Maynard attachment, which will contain 60 primers. The lock will also answer for the common service cap if necessary. The ball is an elongated, hollow, pointed ball, weighing 497 grains, which is about 60 grains heavier than the present round ball. The new model rifle requires but 60 grains of powder, which is 50 grains less than the present service charge of the smooth bore musket, 110 grains. Its great superiority, however, lies in its unerring accuracy, the far greater distance it will send its ball, its more severe execution, and the lighter charge of powder required.

Besides the musket thus described, models of a fine rifle pistol, with 10 and 12 inch rifle barrels, of the same caliber as the rifle musket, 0.58 of an inch, have been prepared, with a false butt, which by means of a hook and spring can be instantly attached to the pistol, thereby making it a rifle carbine, which will fire with accuracy 500 yards. When detached from the pistol, the butt is suspended by means of a belt and swivel ring. This will be a very important improvement for the cavalry service. The pistol lock also embraces the Maynard primer.

It has also been found practicable to alter the barrels of the old muskets to the rifle style. Some of them have been so changed; and it is not improbable that all now on hand at the Springfield Armory—some 255,000—will ultimately receive that improvement.

BOMB LANCES FOR WHALING.

The extent to which gunpowder is now being employed in the manufacture or rather in the capture of oil, is perhaps little suspected by the mass of our readers. Guns for driving the harpoon have, we believe, been pretty generally abandoned, but we are assured by a manufacturer of fuse, who has lately contracted for making a quantity especially adapted to this sub-marine and blubbery location, that the bomb-lance is now being quite extensively employed by many vessels, and that some have sent home from the Sandwich Islands for further supplies. The bomb-lance is discharged from a very heavy musket, and is driven point foremost into the vitals of the animals, where it explodes after the lapse of a few seconds. The quantity of powder usually

contained is about four ounces, and the fuse is set on fire by the explosion of the powder in the gun. Brande's patent bome-lance is the one under notice, and consists of a thin cylindrical shell of iron, armed with a sharp and heavy point of a triangular section. The iron shell is originally open at its rear end, but after receiving the powder and inserting a suitable piece of fuze, the whole is stopped water-tight by a layer of melted lead. The main difficulty appears to be to find a place for a sufficient length of fuse. If allowed to project loosely outside, the water or animal fluids in the wound would be likely to extinguish it, and it is a singular fact that all that portion tightly inclosed within the lead burns instantly, and is therefore of no service in postponing the period of explosion. The method adopted is to insert two of these leaden partitions, between which, a considerable length of fuse may be stored. Thus arranged, and provided with wadding which expands into wings to steady and direct the missile while flying through either air, water, or fish, the lightness is sufficient to allow its discharge from a piece which may be handled by any strong man. Aimed at a vital point, a little beneath the surface of the water, the fuse is ignited and burns at the rate of about seven inches per second, while the boat retreats. The manufacture of these bombs and of the instruments for their discharge, has been for some time carried on at Norwich, Conn.—*N. Y. Tribune.*

THE INFERNAL MACHINES AT SEBASTOPOL AND IN THE BALTIC.

The London *Times'* correspondent gives the following account of the small mines which the Russians have strewed the ground with about their outworks:

I was shown here (at the Mammelon) one of these extraordinary fougasses, or small mines, which are exploded on the touch of the foot, and which the Russians planted thickly about their advanced works. A strong case containing powder is sunk in the ground, and to it is attached a thin tube of tin or lead, several feet in length: in the upper end of the tube there is inclosed a thin glass tube containing sulphuric or nitric acid. This portion of the tube is just laid above the earth, where it can be readily hid by a few blades of grass or a stone. If a person steps on it he bends the tin tube, and breaks the glass tube inside. The acid immediately escapes and runs down the tin tube till it arrives close to its insertion into the case, and there meets a few grains of chlorate of potass. Combustion instantly takes place, the mine explodes, and not only destroys every thing near it, but throws out a quantity of bitumen, with which it is coated, in a state of ignition, so as to burn whatever it rests upon.

The following is a description of one of the machines which are sunk in the Baltic, which have caused so much apprehension among the allied fleets:

Each machine consists of a cone of galvanized iron, 16 inches in diameter at the base and 20 from base to apex; it is divided into three chambers, the one near the base being largest, and containing air causes it to float with the base uppermost. In the centre of this chamber is another, which holds a tube with a fuse in it, and an apparatus for firing it. This consists of two little iron rods, which move in guides, and are kept projected over the side of the base by springs which press them outward. When any thing pushes either of these

rods inward, it strikes against a lever, which moves like a pendulum, in the fuse tube, and the lower end of the lever breaks or bends a small leaden tube, containing a combustible compound, which is set on fire by coming in contact with some sulphuric acid held in a capillary tube, which is broken at the same time, and so fires the fuse, which communicates with the powder contained in the chamber at the apex of the cone, and which holds about 9 lbs. or 10 lbs. At the extreme apex is a brass ring, to which is attached a rope and some pieces of granite, which moors them about nine or ten feet below the surface, so that the only vessels they could hurt, the gun-boats, float quietly over them.

TESTING OF CANNON.

The following notice respecting the plans adopted for the testing of cannon by the U. S. Ordnance Department, at Washington, D. C. is derived from the Charleston, S. C., Standard.

Guns are cast in any shape that may be suggested by the process of investigation, then fired to test their projectile force, then fired until they burst; and when the result has been attained, with every care to determine the causes and conditions of the experiment, sections of the broken metal are carefully drilled out from different parts of the piece, from the muzzle and the breech, and the inside and the outside, and each piece is subjected to a strain to test its tensile strength. In the process of these experiments, one fact has become pretty well established which rather contradicts received opinion. It has been supposed that the cannon, always cooling from without, and the outside contracting, therefore, around the inside still extended by heat, would become more brittle, but this, in such tests as have been used, would not seem to have been the case. A bar cut from the outside of the cannon will generally part with about the same amount of extention as a bar cut from the inside, whether it be taken from a longitudinal or vertical section of the gun. Another fact of some importance, however, has been established. It is found that the strength of the gun may be much increased by taking the weight of metal from the muzzle and casting it around the breech. A gun, for instance, had been cast with a view to this experiment, which was much thiner at the muzzle than cannons usually are, but which was by so much the thicker at the breech, where the charge explodes. It was fired some 1200 times, under every conceivable condition likely to insure explosion, and when it did burst, the fracture occurred at the breech, as is usually the case with cannons.

IMPROVEMENTS IN WAR INVENTIONS.

The effect of the European war during the last two years has been to bring out an almost innumerable number of war inventions in Europe and the United States. In England it was recently stated in the House of Commons, that within a recent period 974 inventions relating to belligerent implements and schemes had been brought before the select committee of the British Board of Ordnance. Some of the more important ones had been carried into effect, 696 had been rejected, and the remainder were then under consideration.

The following are some of the most noticeable improvements which have been made public:—A patent has been obtained by Captain Blakcly, of the Royal Artillery, England, for making cannon as follows: He takes a tube of cast steel, and then surrounds this with external rings of wrought iron shrunk on. He also employs a buffer or spring of air at the butt of mortars to moderate their recoil. He also claims the method of strengthening old guns, by shrinking wrought iron bands on them.

New War Projectile.—The London *Times* describes a new war projectile, the invention of Captain Disney, which has been tried with success. It consists in fitting shells with a bursting charge of powder contained in a metal cylinder, and filling the rest of their space with a highly combustible fluid, which upon exposure to the air ignites every thing with which it is brought in contact. This fluid does not act upon the substance of the shell, is not in itself explosive, and being prevented from leaking by a nicely fitted brass mouth plug, enables the missile to be carried about without much risk.

Aiming with Cannon.—Captain Davison of England has patented the application to cannon of a telescopic sight and cross-wires, or micrometer so that by means of them and a collimator, the piece of ordnance may be brought into its proper position by day or night, after every discharge, without the necessity of observing the object aimed at, after the proper range and aim have been first obtained.

The attention of scientific men in France and England has been called of late to a valuable improvement in artillery, said to have been introduced by Colonel Cavalli, of the Sardinian army. This gun is double-grooved, giving about a three-quarter turn to the projectile, which is of an oblong form, of cast-iron, pointed at the top, convex toward the powder, and having two ribs running lengthwise, to correspond with the grooves in the gun. The London *Times*' correspondent remarks with regard to it:—

"As regards the principle of grooved barrels and ribbed projectiles, there seems no objection to apply the system to guns now in use; for the difficulties once made as to the wearing out of these grooves are practically disproved by guns and projectiles now in the arsenal of Turin, which have been used scores of times, and without any obvious deterioration. But this principle Colonel Cavalli had combined with that of loading at the breach, and when he tried a gun of this kind in England, in 1850, before some distinguished officers of artillery (and which gun had been cast at Stockholm), it unfortunately burst, and there was consequently an unjust prejudice, perhaps, created against it. Even then the fault of the bursting was acknowledged to be in the material and not in the principle, and the official returns of the practice with guns of smooth bore on that occasion are highly confirmatory of the merits of grooves. Since then he has made some further improvements in the method of securing the breech after loading, and, with a gun weighing 66 cwt., loaded with 6 lb. 10 oz. of powder and a projectile of 66 lbs., the following results have been arrived at:

"With ten degrees of elevation, at a distance of 3,068 yards English, there was a lateral deviation of $3\frac{1}{4}$ yards and a longitudinal one of 40; with an elevation of fifteen degrees, and at 4,142 yards' distance, the lateral deviation

was 3½ and longitudinal 48½; at twenty degrees elevation and 4,934 yards it was 4½ and 37; and at twenty-five degrees and 5,581 yards it was 5½ and 19.

"The ground where these experiments were made did not admit of a greater elevation of twenty-five degrees being used, and therefore all calculations beyond that are still speculative; but those who know any thing of practice at these distances will at once perceive the unusual precision arrived at with a very small charge of powder, and all practical gunners are aware of the lateral tendency which a ball discharged from a grooved barrel has to the side it turns toward; to correct which, the inventor has now placed a horizontal scale on the perpendicular one, for the guidance of the commander of the gun; and, to conclude the advantages which this invention seems to possess, the charge does not cost more than that of an ordinary gun.

Graham's Revolving Rifle.—The chambers of this revolving rifle hang perpendicularly, differing in this respect from all other inventions. The use of the rifle is thus rendered perfectly safe. In case a loaded chamber should go off accidentally the charge will go downward, without the possibility of injuring the holder of the rifle, and the lever underneath the next chamber is also thrown up in range with the barrel. The chambers contain eight charges, and can be taken out in a moment. On the very instant another set of eight chambers can be inserted. Thus, after eight charges have been fired, eight more are ready, and so in as many of the eight chambers as may be carried or is required, saving the carrying of any other ammunition.

The Exit Rifle.—This is the name given to a self-priming, breech-loading Minié rifle, recently invented by Mr. Joseph Day, of Hackettstown, N. J. The self-priming apparatus may be attached as well to the ordinary government rifle, and may be properly considered first as a distinct invention. The passage for the caps is capable of containing eighty, which in turn are thrust forward moderately until the hammer is within half an inch of the nipple, when one is sent "flying" into a suitable semi-cylindrical cavity, and immediately forced down upon the nipple and discharged. There is no "sear-spring" in the lock—the main-spring being made to serve all purposes, except such as relate to the self-priming mechanism. In this latter there are two small springs—one to catch in cavities in the side of the channel, and prevent the retreat of the caps as they are forced forward by each movement of the hammer, and the other confines the forward cap until a sufficient amount of the valuable quality termed "push" is acquired to send it rapidly and certainly into its proper place. The loading is effected by allowing the barrel slightly to "see saw." Imagine the barrel of the piece suspended on trunnions like a cannon (except that the trunnions are within about four inches of the breech)—the barrel being kept in line with the breech by the aid of a close fitting ring which covers the joint. When wishing to load, the ring is drawn back by the aid of a false trigger, and the barrel at once presents an open end to receive the charge. A slight jerk now shears off the cartridge and brings the barrel again into line, when the ring springs forward and perfects the joint. The provisions for holding the trunnions and limiting the play of the barrel are very strong, simple, and light, and the whole, lock and all, are finally secured by the aid of one single screw.

Weaver's Breech-loading Fire-arms.—In an improvement patented October, 1855, by H. B. Weaver, of Connecticut, there is a movable chamber at the breech of the gun for receiving the cartridge, the chamber being hinged so as to open up, laterally, like the lid of a snuff-box. The opening and closing of the chamber is effected by means of a trigger guard lever located underneath the stock, the same as in most of the breech-loading fire-arms. There is also a very ingenious self-acting contrivance for putting the percussion caps upon the nipple. By the act of opening the cartridge chamber the hammer is cocked and a cap placed upon the nipple; all that remains to be done is to slip the charge into the chamber and close the same, when the piece is ready for instant discharge.—*Scientific American.*

Mr. Andrew Smith, of England, has recently exhibited a model of a gun, arranged for the purpose of employing oxygen and hydrogen gases, produced from the decomposition of water by galvanic electricity, the projectile force from the combustion of which is nearly double that of gunpowder. The generation of the electric gases takes place in a chamber beneath, the reiterating propelling force being admitted intermittently behind each ball by means of a valve, the whole being contained in the compass of the carriage of an ordinary ship's gun, or battering cannon, and but little exceeding them in weight.

The guns intended for the new steam frigate Merrimac, recently launched at the Charleston Navy Yard, are of peculiar construction, being very large at the breech, and beginning to taper abruptly near the center, terminate small at the muzzle. They are provided with an elevating screw, sufficient to elevate 9° 45′, and depress 7° 30′. The carriages, also, are of a new model, having no after trucks. The guns thus provided will be more steady upon the deck, and not so liable to break from their breechings at sea, while in firing the recoil will be sufficient to throw them back.

Improvement in Percussion Caps.—M. Neron, of Paris, at a recent meeting of the Institution of Civil Engineers of Great Britain, exhibited an ingenious mode of placing detonating caps on the nipple of a rifle or a musket. The apparatus consisted of a tube containing twenty-two caps, placed parallel with and close beside the barrel, being partially inserted in the stock, and so arranged that while the near end was attached by a pin to the hammer, the further extremity was free to travel in a slot. Its action was very simple—the tube being filled with caps from a reservoir, several of which would occupy but a very small space, the end cover was turned down. On drawing the hammer to half-cock, the tube was drawn forward until a cap was brought over the nipple, and at full-cock the cap was pressed down upon it. After firing, if any portion of the copper remained attached to the cap, it was removed by a small picker preceding the tube, on its being again brought forward to repeat the operation. It was evident that by this simple and cheap addition to any fire-arm, much time must be saved in loading, and a great waste of caps must be avoided, while about twenty-five per cent. of copper was saved in making the caps—and they were kept dry in the reservoir instead of being exposed to damp and running the risk of not exploding, as had occurred frequently in action on recent occasions in the Crimea.

Improved Artillery Vent.—A new artillery vent has recently been tried at

Woolwich, England, upon an iron six-pounder. The arrangement consists of two pieces of brass, made to fit a groove bored in the vent-field, the vent passage being between these two pieces. After the insertion of these pieces of brass, they were screwed down, and on the top of them, in a line with the surface of the gun, a nut was placed to hold them tight. If an enemy spiked the gun in the usual manner, by removing the nut on the top by means of a wrench, the vent was unscrewed, and the spike taken out. After each round was fired the vent pieces were taken out, examined, and replaced; after each round the vent sank deeper into the gun. Ten rounds were fired, and after the tenth a spike was driven in, which burst the vent, and the pieces of the vent remained in the gun. Every time the vent was taken out previously it was found to be twisted.

Improved Bullet-mold.—A patent has been recently granted to William Aston, of Middleton, Conn., for an improved bullet-mold, for casting the Minié bullet, the chamber of which is a hollow cone. The object of the mold is to cast such bullets with greater facility than by any of the molds heretofore used. To form such bullets, the mold must be made with a core. Those now used open longitudinally, and have a fixed core; this new mold has a movable core, and opens transversely. It is so made as to allow air to escape when running in the molten metal, and to cut off the surplus when the mold is full.

A machine for making Minié balls has been recently invented by Mr. W. A. Sweet, of Syracuse, N. Y. These bullets differ from the common round bullet in being of a conical shape with a cavity in the base. Hitherto they have been invariably cast in molds in the same manner that the common bullet is cast, by which process it is impossible to make balls of equal weight or free from imperfections, which faults, as they exist in a greater or less degree, affect the accuracy of the rifle. The machine is comprised within a space of a foot square, and weighs about 65 pounds. There are no springs or cogs in it, and there is very little liability of its getting out of order. The bars of lead, rolled to a proper thickness, are fed into a hopper and run under a die which "swedges" out the bullet, and at the same instant the cavity is pressed into the base; the bullet is discharged from the die, which again receives the bar and repeats the process. The machine thus makes two bullets a second, or 120 a minute, and is capable of even faster work.

DIFFICULTIES ATTENDING THE CONSTRUCTION OF LARGE ORDNANCE.

During the past year, Mr. Nasmyth, the well-known English mechanician, constructed for the British Government an immense experimental gun of wrought iron, the weight of which with its carriage was intended to be 50 tons. It was also expected to throw a solid shot of half-a-ton weight four miles with a charge of 225 lbs. of powder. In manufacturing this immense piece of ordnance, it was found that the thickness of the mass so retarded the cooling gained by successive heatings, that portions of the metal assumed a crystalline form, and weakened the whole to such an extent that its use was considered impracticable. This fact has attracted considerable attention in

the English scientific circles, and Dr. Noad has recently made public some results attained in experimenting at the Welsh iron mines of great interest, considering how extensively iron is now used for bridges, cables, and supports. Dr. Noad says:—"The tendency of iron to pass from the fibrous or tough to the crystalline or brittle condition is promoted by various causes; every thing, in fact, which occasions a vibration among its particles has this tendency." He then describes his experiments, which prove that the metal may be made to pass from one state to the other:—"Seeing a large quantity of iron chain lying about, and learning that, though scarcely worn, it had been laid aside in consequence of the breaking of some of the links, I examined several from different parts of the chain. I found that a single smart blow with a hammer was sufficient to snap the metal, the fracture of which was crystalline, and its brittleness such that it could without difficulty be broken into small pieces under the hammer. I now heated strongly in a forge some of the broken links, and allowed them to cool very slowly underneath a bed of fine sand. After the lapse of 24 hours they were examined; the metal was found to have recovered its tenacity, it could no longer be broken to pieces under the hammer; and when at length, after repeated heavy blows, it did partially yield, the texture of the metal was found to be perfectly fibrous—every trace of a crystalline structure had disappeared." Dr. Noad thinks that the iron of the Nasymth gun has been crystallized by continuous hammering; and he suggests that its fibrous condition may be restored by annealing.

ARTILLERY AND PROJECTILES.

In a discussion which occurred at the last meeting of the British Association on the subject of artillery and projectiles, Dr. Scoresby stated, as the results of experiments he had made, that the quality of iron might be effectually tested by its effect in counteracting the deviation produced on a compass by a magnet placed in opposition to it. Mr. Neilson, iron-founder, gave, as the result of his experience, that, if repeatedly heated, or heated without being subjected to severe hammering or pressure, the center of a mass of iron was sure to become crystalline and friable. Mr. Rennie thought the defects of the artillery of the present day were, in a great degree, to be attributed to the competition in cheapness among manufacturers. Sir E. Belcher stated that, in engagements which he had witnessed, much more severe than that of Sweaborg, no accidents whatever had occurred to the ordnance. He suggested the employment of guns similar to those of the Chinese, with strong cast-iron breeches, the direction-tube being a matter of little moment.

Mr. Robinson stated that rifled guns are more liable to burst, because the force necessary to explode a ball from such a piece of ordnance is much greater than that required for a plain bored gun; and also that a rifled gun is much more liable to burst or be rendered useless from frequent discharges, because of the force necessary to cause rotation having to be added to that which causes projection. Dr. Robinson alluded to the bronze guns of the Dardanelles, which are of three feet bore, used against our fleets not many years

since, and which were made by Mohammed II., and asked whether bronze might not now be used instead of cast-iron. He suggested the probability that on experiment railway-iron might be found better than cast-iron for ordnance.—Mr. Fairbairn said the material of which guns were made was not so good as it was fifty years ago. He was present at Woolwich and saw the practice of the guns there. One of them seemed properly molded in every part; but it was found that the welding in one part was not sound, and the gas getting into the fracture operated just like a wedge, and split it as if it had been made of paper. Another was formed of steel bars, with a breech of cast-iron attached to it. The breech was entirely blown off the gun, and the bars torn asunder. It appeared to him absolutely necessary to have such a material as would not only resist the severe impulse which the discharge of the shot caused, but be perfectly solid in the mass. If they were made of parts, such as the staves of a cask, these opened, and the result was the fracture of the gun. The Stirling gun was a mixture of wrought with cast-iron, and it certainly carried one fourth or one fifth more of common pressure, but when applied to artillery under Colonel Dundas, after a few rounds the pieces were burst. The mode of casting these large guns is also defective. They were generally cast solid, and in the cooling the metal was left exceedingly porous in the center, and when one began to bore out the gun, one found it was not of so close a texture inside as out. Now they took the precaution of having cores in the middle, through which they sent a current of cold water to cool the inside simultaneously.—Dr. Robinson: About a century ago they cast them hollow, and it was thought a great improvement to cast them solid. —Mr. Fairbairn believed if they went about the work more carefully, they would arrive at a safer and better mode of casting than at present. If the mortars were made a foot longer, he believed, instead of sixty pounds, fifty pounds of powder would carry a shell of the same weight, and to a greater distance, and with greater accuracy. He thought, in the mortars, a great quantity of the metal was in the wrong place in a great many cases. They had the same thickness of metal at the mouth as at the breech, whereas it might taper without any danger, the pressure being less at the mouth. He explained an ingenious ball, in which there was a spiral tube, so that the ball with an ordinary gun suited all the purposes of a rifle; but he did not know whether the experiment was successful or not. Till lately guns of the ordinary caliber would stand six hundred or seven hundred rounds before they were injured, but they always gave way at the vent. But they got into a plan of putting a tube into the vent, which made them stand six hundred or seven hundred rounds more. Now-a-days the same guns would not stand one hundred rounds; perhaps the reason was that the metal was not properly selected. The iron procured by hot blast is excellent for machinery purposes; but he did not think it the best for artillery. With regard to the Turkish artillery, he was at Constantinople some years ago, and they are almost all made of a mixture of brass and tin. Mr. Mare, at Blackwall, is now constructing a gun three feet in diameter—the breech of cast-iron and the tube of direction of wrought-iron. Whether it would answer or not he did not know.—Dr. Robinson: The bronze guns failed in a very remarkable manner.

The ball rises on firing, is deflected on the gun, and if the gun is long it is again deflected, and deep holes are made in the barrel owing to the softness of the metal. Could not a thin lining of steel or wrought-iron be inserted into the tube?—Mr. Fairbairn thought it was very difficult to form any gun that differed in its parts. He would prefer to have a gun perfectly solid—of steel, if they pleased; for he had seen excellent specimens of steel manufactures from Prussia in the Great Exhibition, and well calculated for making field artillery. The artillery of the present time was much larger than it was in former times, and allowance must be made for that.—Mr. Lawrie proposed to have no vent all, but to fire in the manner in which rocks are blasted, by means of galvanism. This would prevent wearing at the vent. He hoped artillery would be brought to perfection, for as weapons had improved war had decreased in brutality; and he hoped there would be a good stand-up fight for it, in order that they might have a lasting peace.—A Member stated that some hydrostatic presses had been made of cast-iron with a case of wrought-iron, at Mr. Downie's works here, and had stood an immense pressure, but they had not as yet tried it on guns.—Mr. Fairbairn asked if the gun made at Mr. Downie's had been cast in such a way as to cause an amalgamation of the cast and wrought-iron. If that were the case, he had no doubt it would secure great strength. He had a doubt, however, that there was a difference of ductility which would cause separation. It had occurred to him that they might be cast under extreme hydrostatic pressure. They had cast them at Woolwich with nineteen feet of iron on the gun, but he did not as yet know the result.—Mr. Sykes Ward thought a gun could not explode so readily if the powder did not impinge directly on the ball.

In reference to the employment of large ordnance upon naval vessels, Lieut. Maury in a recent published communication says: "These new big guns will impart an entirely new feature to sea-fights. Hereafter, and when they are properly appreciated in the right quarters, we shall have no more such costly things as the Pennsylvania, and other seventy-fours; and in the result of engagements that may follow, seamanship, maneuver, and position will be matters of comparatively small importance. Marksmanship, and marksmanship alone, is to decide the battle, when these big guns are brought into it. He whose shot tells first will be almost sure to whip; and the real practical question now to be decided is as to the degree of marksmanship that is attainable with these guns at long range, and when the aim is rendered most difficult in consequence of the motion of both marksman and target by wind and sea."

It is also worthy of notice that in the recent naval operations in the Baltic and Black Seas, the efficient vessels have been the small ships and steamers armed with big guns, while the huge ships of one hundred and twenty guns have been comparatively useless.

IMPROVEMENTS IN SEWING-MACHINES.

A large number of patents for improvements in sewing-machines have been granted during the past year. The following are some of the most important:

Harrison's Improvement.—The object of an improvement by James Harrison, Jr., of Milwaukie, Wis., is to give the cloth a feed-movement independently of the needles, instead of by the needles, as in the Avery sewing-machine. For this purpose both needles are, for a time, withdrawn from the cloth, to leave it free to be acted upon by suitable feeding mechanism. Other parts of the invention are to provide means for holding the material to be sewed, and admit of its being liberated before and during the feed-movement; also means of causing the interlacings of the two threads when the seam is formed, to be always as close as desirable to one surface of the material, whatever may be the thickness of the material, and notwithstanding any variations in its thickness; also in a self-adjusting arrangement of the feeding apparatus, which permits the sewing of stuff of different or changing thicknesses, without any stoppage of the machine.

Cowperthwait's Improvement.—Improvements patented by C. J. Cowperthwait, of Philadelphia, consist principally in the employment of a weighted trip-lever, instead of spring-pressure, in feeding the cloth, and in an oblique arrangement of the shuttle race relating to the line of the feeding movement, or the sewing, whereby the stitches formed by the needle and shuttle are all caused to be produced in line with each other, instead of zig-zag, as in other machines.

Robinson's Hand Sewing-Machines, with Roper's Improvements.—This a very singular-looking and acting apparatus. It puts us in mind of a hand printing-press, more than any thing else. Two needles are employed, carried by two long arms, one above, the other below the table. One thread only is used. There are notches near the points of the needles, answering to eyes, which catch the thread, and alternately carry it through and out of the cloth, forming the same kind of stitches that are made by hand, to wit: back-stitches, half and quarter back, side, sail, quilting, hemming, running, etc. The work which it performs is strong and beautiful. Price of machine $150.—*Scientific American.*

Singer's Improvements.—Several important improvements in sewing-machines have also been patented during the past year by J. M. Singer, of New York, well known from his connection with this machine from the commencement. They consist in a new plan of stitching, and in a novel method of embroidery, whereby ornamental designs, of every description, can be wrought out on the cloth in the most splendid manner, with great precision and rapidity. Thread, silk, worsted, gold lace, and other species of embroidering stuffs, varied in colors to suit the taste, may be laid on with singular ease and facility. The work performed is, moreover, very firm and durable.

Musical Sewing-Machine.—Messrs. Wheeler and Wilson, of New York, exhibited at the recent Fair of the American Institute a combination of the sewing-machine and the melodeon. The apparatus has the appearance, externally, of a small parlor side-board or escritoir. You lift the front, and find a handsome set of piano-keys. Close it, and turn back a hoop on the top, and you have a complete sewing-machine, conveniently arranged; concealed below, within side doors, are two pedals, one for the music, the other for the

sewing-machine. When the lady becomes tired of playing at sewing, she may change her foot to the other pedal, open the melodeon part, and discourse music. The price of these contrivances is $200.

CHEAP PICTURES.—HOW MADE.

A recent article in *Chambers' Journal* gives the following interesting account of an extensive branch of business now carried on in England, viz.: the manufacture of cheap oil-paintings, or paintings on glass. "It was about the time of Hogarth's death that some ingenious fellow, with an excellent eye to business, hit upon the mode of manufacturing those paintings on glass which for more than three-score years have deluged the country, and which even now are sold in considerable quantities, though the traffic in them has declined, according to the testimony of a rather extensive manufacturer, to less than one twentieth of what it was within his recollection. These paintings, which the reader will immediately call to remembrance, are nearly all of two uniform sizes—14 inches by 11, or 14 inches by 22. They are what they profess to be—oil-paintings on glass; and having an undeniable title to this description, they took amazingly with the common people, and sold in immense numbers. We may form some notion of the traffic from the fact that it is hardly possible even now to walk through a village or market-town without seeing them exposed for sale, or to enter the cottage of a poor man, or the farmer's kitchen, without finding a pair of them, and it will be oftener, half a dozen, hanging on the walls. The smaller size predominates, the larger ones being comparatively rare—a circumstance which may be accounted for by their liability to fracture, the cheapest and thinnest glass being invariably used. Viewed at a little distance, they have a striking resemblance to old oil-paintings. They have all dark rich back-grounds—are mostly on sacred subjects—show strong contrasts of light and shade, and but a small variety of tints, for a reason which will be obvious presently. A slight blow cracks the thin glass, and then they are ruined, until the peddler comes round with a duplicate of the same subject, and for a couple of shillings or so, makes all right again. We must not omit to notice one peculiarity in these glass-paintings. Though their number is legion, and their designs almost endless in variety, yet these are all, or nearly all, the property of the manufacturers. It is rare, indeed, that one meets with an instance of piracy from the works of living artists, or even of copies from standard or classical works—the only exceptions being in the case of single heads, such as Madonnas and Ecce Homos. It is but fair to state, however, that this recommendatory fact is not attributable to the honorable independence of the manufacturer—we shall not call him artist—so much as to the necessities of his trade, which drive him to the use of the simplest design and the fewest possible tints, in order to make the more profit. Most of these pictures are made in London, and the manufacturer generally has recourse to some struggling artist for his design, who, for a couple of guineas or so, will supply him with what he wants; and he can get the engraving done for even less.

The manner in which these paintings are produced is a mystery to all but the initiated; it is a riddle even to the practical artist; and it is possible that

the reader who has tried to penetrate the secret, after puzzling his brain to no purpose, has given it up in despair. We shall take the liberty to make some revelations on the subject which will clear up the enigma; and in order to do it effectually, we shall introduce our friends to the atelier of Mr. David Daubham, who at present holds a large share of the country trade in his hands.

"Mr. Daubham's place of business is in Leather Lane, where, however, he is under no necessity of making any demonstration, and does not make any. His atelier is a roomy brick-chamber in the back-yard, lighted from one whole side. Upon entering, we find Mr. Daubham engaged in a warm discussion with a glassdealer upon a question of sixpence in the gross of 'eleven-fourteens.' Pending the settlement of the debate, we look round amid an odor of oil and strong varnish almost too much for our olfactories. A couple of girls and four or five lads are busy in the prosecution of their work. Before we have watched the several processes for five minutes, the whole art and mystery is as patent to us as it can be to Mr. Daubham himself. The glass being first cleaned, an operation in which extra carefulness does not appear to be necessary, the surface which is to receive the picture is rubbed completely over with a preparation of turpentine varnish. Upon this, as it dries rapidly, an impression from the engraved plate is laid, and rubbed firmly upon the glass with the palm. It is then left to dry till a batch of a hundred or so is done. The paper upon which the impression is taken is the flimsiest material that can be used, and is rubbed off by a momentary application of the sponge, leaving every line and touch of the print adhering to the varnish. But the varnish has not only fastened the ink of the print to the glass, it has also primed the glass for the reception of the colors. In this state, the squares of glass are stuck up on a kind of scaffolding which may be called the easel, with their faces to the light. The easel will hold a score of them at a time. Then each of the lads seizes a pot of color and a brush, and sets to work at their rear. One covers all the faces and hands with flesh color; another daubs on the greens; a third does browns—and so on, till all the tints are daubed on and the glass is covered. The whole twenty do not take twenty minutes in the coloring, unless the tints are more numerous than they usually are. It seems unaccountable that any pleasing effect should be produced by such a process; but in fact, as the engraving supplies all the shading, the effect is not bad, considering all things; and there is no reason why really excellent pictures should not be produced by a similar process, if it were thought worth while to improve it by cautious experiment—though it would be impossible to paint even a decent sky in such a way. Hasty and careless as the work appears, it will be easily conceived that a certain amount of dexterity is necessary in laying on the colors within the prescribed outline; and it must be done quickly, lest the varnish be disturbed, in which case the colors would not adhere.

"The pictures thus finished have only to be framed in order to be ready for market. Mr. Daubham contracts for his frames with a firm in the neighborhood, and finds that he has as much as he can do himself in putting the pictures into them—a job he does not choose to trust to his "hands," who would break too many. The frames are of two kinds—wood, and shining lackered metal pressed into a sort of flowery pattern by a die. The far greater propor-

tion of his goods are, however, sold to the trade unframed. The market-price was 9s. a dozen previous to the war, but has fallen a trifle since, though not so much as the demand. The wooden frames cost not quite the same—and seeing that these precious works of art are hawked at the present moment at from 6s. to 7s. the pair, it is clear that profit has not been lost sight of. The number of manufactories similar to Mr. Daubham's, he tells us, is eight or ten, exclusive of the small shops of amateur daubers in the trade who get up pictures of exceptional sizes at a low rate by working from exhausted plates purchased as old metal. Looking to the vast numbers which may be and are produced, amounting to several gross a week from a single workshop, we are puzzled to know what becomes of them, considering that the country demand has so greatly declined. "But," says Mr. Daubham, "you don't take into account the exportation. They goes abroad, sir. A hundred gross, at least, of my pictures goes to Catholic countries every year. Most of my plates is Catholic subjects—Madonnas and Martyrs, and the blessed saints St. Francis, St. Januarius, St. Nicholas, St. Theresa, and so on. Then I've got twelve different Holy Virgins, and lots of subjects that is Catholic or Protestant, and will do for the home or export market either. I pack 'em without frames in racks made on purpose, and they travel safe enough. The poor people abroad likes to have their patron saint; and then they vows a picture to the Virgin perhaps, and so they get stuck up in churches. I've heard tell that you can see 'em in most of the churches in Italy, as well as in Spain and Portugal. I used to send twenty to thirty gross to Oporto every year, but the vine-disease has very much injured that trade, and I don't send half as many now." We commend Mr. Daubham's candid summary to the notice of bookmaking travellers and tourists, some of whom, if we are not very much mistaken, have dwelt with curious yet blundering minuteness upon these identical pictures, without conjecturing that in so doing they were describing the products of English industry. But we must leave the obliging Mr. Daubham to the prosecution of his trade, and take a look at another and more pretentious branch of equivocal art.

"We have said that the home trade in the productions of Mr. Daubham and his congeners, has of late greatly declined. This is not because the love of art has declined, but because it has become more ambitious—we can hardly say more discriminating. The glass-painting has at length been pretty generally discovered not to be the genuine thing; and oil-paintings on canvas are now extensively superseding the oil-paintings on glass.

"In the new trade, the Jews mingle very largely, and take the lead. They get up new frames from old worn-out moulds, gild them with Dutch metal, clap a landscape of a good thumping size into them, and sell a pair of them for five and twenty shillings. They have a gorgeous appearance, and impart an air of luxury and grandeur to a poor man's cottage or a farmer's parlor, which pleases him none the less that it is barbarously out of keeping with all the rest of his domestic havings. The middle classes accept the same bait; and even in London, several thousands of such cheap wares are annually retailed. Nothing is more common in the streets of the suburbs than the spectacle of a wandering Jew, with a couple of pair of these tawdry pictures, slung round his should-

ers, back to back, and stopping to display them at positions favorable for effecting a sale. Both in London and in the country towns and villages, they are sold by the furniture-brokers in large numbers, and, like the paintings on glass, they too are exported—not to Catholic countries, where they would be a drug, but to the colonies, and especially to the emancipated negroes of the West Indies, who have a prodigious appetite for violent colors and gilding."

PORPHYRITIC SARCOPHAGUS FOR THE DUKE OF WELLINGTON.

A huge sarcophagus, shaped from a block of porphyry, for the reception of the remains of the Duke of Wellington, has been constructing during the past year in Cornwall, by the orders of the British Government. It is thus described by the London *Athenæum*:—"This enormous stone—weighing seventy tons when it was originally detached, and wrought on the spot where it was formed—is of a grain so impenetrable as almost to defy the cutter's craft. The sawing of it into halves was a long and painful task, and the two men now employed in hollowing it out seem given up to the most slow-going task conceivable at the time present—since more than two can not work, and the impression made by their picks in the huge mass is a thing to be measured from week to week, not day to day. There is ten months' more work to be done ere the adamant rock will be shaped and smoothed into the required form. The color is of an intense deep gray, mottled with black and pale buff, and streaked with veins of white."

IMPROVEMENTS IN PRINTING-MACHINES.

Brown's Color Press.—A printing-press has been recently patented by Mr. Samuel Brown, of Syracuse, New York, which is capable of printing four colors at one impression, and will throw off about 500 impressions per hour. The press is on the "platten," or "flat impression" principle, and in general appearance resembles the Adams's press. Each colored ink is distributed on a separate roller, and all move horizontally across the form at the same time, but at different levels—the blue roller, for example, being beneath the black, and the yellow and red ranging still further below. Those portions of the "form" which are to be of any given color are "locked up" in separate small "chases," and as the bed of the press sinks down after every impression, these chases are stopped by pins projecting from the sides, each at their proper level, to receive the desired color.

Babcock's Polychromatic Press.—This press, patented by Messrs. Babcock, of Westerly, Rhode Island, is far superior to the above for every variety of small work. In this the paper is laid upon a revolving cylinder, or rather parallelopiped, with four flat faces, and is firmly held by the usual means. The paper is laid on the upper face, after which a quarter revolution presents a new face to receive paper, and presents the paper already laid to the action of a form which moves horizontally from the side. Another quarter revolution presents this first sheet to the action of another form, rising from beneath, of a different color; and a third movement gives it a third impression. A fourth

movement presents it at the top again, when the printed sheet is removed and another laid on. The three forms, one form upon each side and one form beneath, move up simultaneously against the three faces, while the hand of an attendant is occupied in changing the paper on the fourth. The inking rollers, of which, of course, a separate set is provided for each form, perform their duties admirably, moving once backward and forward over the form, while the paper cylinder is changing positions. The "register" of this press is perfect—a point of the first importance in color printing, as the slightest misplacement of an impression frequently ruins what would otherwise be a fine effect. The work is performed rapidly and well, yet without violent motions or concussions, and the number of inks employed is three, although by a trick well known to the craft—allowing some lines to receive the full and perfect impressions, thus superposing one color upon another, six actual varieties may be produced.

Jones's Typographer.—This machine, the invention of Mr. John Jones, of Clyde, Wayne Co., N. Y., differs essentially from other printing apparatus, except that the appearance of the work produced is nearly the same. The typographer, in short, is an invention by which cards, notes, envelops, etc., may be printed by a slow process of producing one letter at a time, as in ordinary writing. The machine is light and portable, and may be placed on or within any ordinary writing desk. The paper to be printed is wound upon a small cylinder, and is fed forward by suitable automatic mechanism. A horizontal ring or wheel, of about twelve inches diameter, is fixed on a vertical shaft, with liberty to revolve freely, and also to move vertically. To the circumference of this ring are attached, at equal distances, all the letters of the alphabet in succession, with the addition of numerals and capitals. The faces of all these types are directed downward, and the paper cylinder is so placed underneath that, on depressing a lever connected with the type wheel, the paper receives a distinct impression from one, and one only, of the types, and by moving the lever horizontally in either direction, any required letter may be thus produced. To insure accuracy of position in this respect, and also to facilitate rapid manipulation, a device has been adopted, consisting substantially of a stout ring of cast-iron fixed on suitable standards, just exterior to the type-wheel, and having its upper surface filed into plain triangular notches, to receive the lever when depressed. Each notch corresponds with a letter or figure on the type-wheel; and to aid the hand in finding correctly the true position before depressing the lever to the point of actual contact between the type and the paper, the lever is made double, the lower portion being held by a delicate spring so much lower than the hand that it falls readily into the notch, and guides the upper or true lever in its descent. The machines complete can be manufactured at a price which will allow of their employment for children's toys, and perhaps nothing can well be devised to be more instructive and entertaining to a vigorous and ingenious boy than the possession of such an instrument. The inking is performed by two small rollers, which are continually pressed against the lower surface of the type-wheel, and necessarily distribute the ink by every horizontal movement of the lever.

Davis's Oscillating Printing Press.—A press, highly recommended, has been

recently invented by Merwin Davis, of New York City, which is intended to supply a want of many small printing establishments, viz., a press expeditious in its operations but of moderate cost. The bed of this press, which is flat, is mounted on a strong column, *oscillating* from fixed bearings through the intervention of a crank and connecting-rod. The bed, consequently, moves in a circular path. By this arrangement the necessity of a "track" for the bed is obviated, and a considerable amount of friction is avoided, thus rendering it more easy to operate than any other press of equal capacity. The bed being counterbalanced, its momentum is overcome without jar or unsteadiness. The impression is produced by the segment of a cylinder, which also oscillates from a fixed point. The "fingers" for holding the sheet are on the front of the segment. In printing, the cylindrical surface of the segment and the plain or flat surface of the bed move forward in concert, being geared together to prevent "slurring;" but they disengage on the completion of the impression and permit the segment to return (with the printed sheet) to its starting-point in advance of the bed, which continues to move forward until the whole surface of the "form" has passed under the inking-rollers. The "sheet-flyer" is located on the column (which supports the bed), its upper edge lying against the rear edge of the bed; and as the printed sheet hangs from the "fingers" of the segment, it is caught by the "fly" in the backward oscillation of the bed and column. As the same "fingers" which draw in the blank sheet do not relinquish their hold until the printed sheet is caught by the "fly," no tapes are required, and of course no adjustment of tapes or fly in changing from a large form to a small one, or *vice versâ*. The distribution of the ink on this machine is effected in a superior manner, and the inking rollers (ranging in numbers according to the quality of execution desired) are so conveniently arranged that they can be put in or taken out of the press in a moment.

Ames's Polygraph, or Copying Machine.—Mr. Nathan Ames of Saugus, Mass., is the inventor of a "polygraph," or machine for writing several copies at the same time. The device is simple and ingenious, and consists mainly of light wire levers so connected together that whatever motion is given to one will be communicated to the others with exact precision. A pen-handle is connected by a flexible joint to the extremity of one lever, and the effect is produced by a movement precisely like ordinary writing. Common gold pens are employed, and ink is taken at intervals in the usual way, a sufficient number of inkstands being suitably located for supplying both or all the pens by the same movement. All the practical difficulties are admirably surmounted, and perfect copies are produced with the utmost ease.

Improvements in Copperplate Printing.—The following is the claim of a patent recently granted to S. W. Lowe of Philadelphia, for improvements in copperplate printing: "I claim coating the plain or unengraved face or surface of the plate (which is intended for leaving the white or unprinted surface of the paper) with a mercurial amalgam, that will have the effect of preventing the ink used in printing therefrom, from adhering to or soiling the same, while the figures engraved or etched thereon, readily receive the ink, and thus admit of printing from the plate, by a letter or any other press, either from the plate alone, or from the plate in the same 'form' with the type, without

the 'wiping' heretofore required in printing from steel or copper plates, substantially as described." It will be observed that the patentee intimates, in his claims, that if the steel or copper plates are covered with a mercurial amalgam, as he proposes, they may be printed on common presses, with types, the same as wood engravings. Should this discovery prove thus practicable, it will be a valuable auxiliary to the typographic art.

MACHINE FOR DISTRIBUTING TYPES.

Attempts to facilitate the setting of type have been very frequently made, but we have now to chronicle a very beautiful, ingenious and, so far as tested, very successful machine for *distributing* or returning type to their boxes after the printing is completed. The inventor is Mr. Victor Beaumont of New York. The machine is automatic and distributes with perfect accuracy every thing but two-em and three-em quadrats without any attendance except to supply the matter at short intervals. The types are carefully picked apart and are left standing in lines suitable for a type-setting machine, or tumbled unceremoniously into boxes, as may be desired, the latter being easier as requiring less labor and care in their removal by the attendants. The principle on which the machine is able to discriminate and put each type in its appropriate place is that of feeling, not the face, but the sides of the body. Each type is prepared expressly for the purpose by cutting three nicks on its edges, differently arranged for each letter. The letter *a*, for example, is manufactured with three nicks, called one, two, and three, counting from the highest; *c* has one, two and four; *b* has two, three and five, etc. The channel leading to each box is provided with a mouth of the same form, carefully executed in hardened steel to withstand the wear, and the lines of type are pressed up successively against all these channels until the right one is presented, when the first type in the line pops in, leaving the next to commence a similar round. The receiving channels are arranged in a circle, faces inward, and the lines of type to be distributed are ranged radially in a horizontal wheel of somewhat less diameter. This wheel is properly geared and rolls around within the inclosure, presenting each type rapidly, but gently, to every aperture. The lines are thrust outward in the wheel by suitable springs, which are simultaneously compressed by a simple movement when it is desired to supply more matter. In working out the details of this machine the most beautiful simplicity has been arrived at, and every type is seized, on entering its proper channel, by a spring lever of sufficient force to tear it from its fellows, however adhesive may be its alkaline and inky bond. A similar lever guards the exit of each type from the wheel, and the hold is slackened only during the instant it presses fairly against the steel mouth of a channel for its reception. Thirty lines are received at once in the wheel, and the machine has been for several months in operation without appearing to wear, or otherwise injure the sides of the type. The nicks cause a slight annoyance by catching the rule in setting, but this evil will probably be overcome by practice. Each machine will distribute but one size of type; but the inventor states that they may be so constructed as to be easily adapted to the different

sizes of small type. If worked by hand, one man or boy can distribute 12,000 ems per hour, and with scarcely a possibility of an error of a single type; whereas by the usual process of hand distribution, 3,000 ems are about the average. The machine can be worked by steam, and one man can then attend to three of them, making the total distribution in one hour 36,000 ems.

SETTING TYPE BY MACHINERY.

It is not generally known, says the N. Y. *Tribune*, that five full-sized and expensive machines are in full tide of operation in setting type in the establishment of Mr. Trow, of New York. There is believed to be one in use to some extent in Paris; but with this exception these are the only machines actually working for this purpose within our knowledge. These five give employment to ten large, and an equal number of small girls, with a foreman to oversee and one additional female to supply the machines with type. Two compositors alternately relieve each other, first setting and next justifying a quantity of matter, while the smaller attendants busy themselves in distributing and arranging the type for the machines. Three thousand ems of long primer have been set per hour, or twenty-six thousand in a day of ten hours, by one girl; but much depends, of course, on the skill of the operator. The extreme capacity of the machine is ten thousand per hour; but this limit will probably be never reached. The machine is driven by a band on a pulley, and the labor of setting consists in fingering a set of keys like a piano. Each kind is carried forward on a separate band, and deposited continuously on a single tape running diagonally across the line of the first. From this second tape they are dropped into a wheel, which, in turn, leaves them standing single file on a long galley, from which they are taken and made up into lines of proper length. The enterprise has not until quite lately been made to assume a form in which it appears pecuniarily profitable, and even yet must be reckoned as a hopeful experiment rather than a triumphant success.

IMPROVEMENTS IN MACHINES AND IMPLEMENTS FOR WORKING WOOD.

The *Scientific American* notices the following improvements in planing machines exhibited at the late Fair of the American Institute:—

Barlow's Rotatory Planing Machine is remarkable for the small space it requires. It is very compact, hardly occupying half as much room as an ordinary carpenter's bench. The operating power necessary is also very small. It planes with great rapidity, and produces work of the very best quality. The machine at the Palace will plane lumber 22 inches in width, or less, and 2½ inches, or less, in thickness. The cutting is done on the under side of the board. The frame of the machine is in two parts, hinged, so that the upper part can be turned over whenever desirable, and the cutters thus handily got at. One of the feed-rollers is carried in the upper frame, which is almost the only part of the machine that requires adjustment. Changes of thickness are made in the most convenient manner, by raising or depressing the upper

frame. The cutters consist of long straight edges, of the same length as the machine is wide. Price $500.

Morse's Patent Planing Machine.—This machine planes both sides of the lumber at once, tongues and grooves at the same time, and if the board is wider at one end than the other, reduces it down and brings it out finished, of equal dimensions throughout. The tongueing is done in a peculiar manner, viz., by simultaneously grooving the board on both sides, thus cutting through and leaving a smooth rounded tongue, which is superior to the tongues made by cutting down on the edges of the lumber. This machine appears to have the combined effectiveness of two or more of the ordinary planing machines. It turns out superior work. Price $1000.

Gray and Wood's Planing Machine is a simple-looking affair, operates very easily, and does superior work. The cutters are long straight edges attached to a rapidly revolving shaft. Planes 25 feet per minute; requires from one to four horse power, according to stuff; can be used for cornice-sticking and all other kinds of work. The cutters are arranged above the board, which is placed on a traveling carriage like Daniel's machine. Price of a machine capable of planing boards 8 feet long, 20 inches wide, only $210.

Gear's Carving Machine.—This improvement is intended for use in the production of ornamental carved work for furniture, etc. The stuff is first cut out into the desired outline form by means of a common scroll saw, and then brought to the machine to be finished up. The apparatus consists of a common table, up through the top of which two or more cutter heads project. The sides and edges of the stuff are worked and finished smoothly by being brought in contact with the cutters, which revolve 4000 times in a minute. One of these machines, we were informed, will save the labor of 30 or 40 men. Price $300. By changing the form of the cutters, the design of the carving is also changed.

Lever Plane.—An improved joiner's plane has been recently patented by W. S. Luffborough, of Rochester, N. Y., the principal features of which consist first in the employment of cast-iron instead of wood to form the main body of the tool, and second in a novel arrangement for securing and adjusting the iron or casting portion. This plane, which is designed to take the place of those ordinarily employed by carpenters, joiners, ship-wrights, etc., is of about the same weight, but much thinner than those now in use, and the hand of the workman is consequently brought down to a position much nearer in line with the resistance. This advantage, although reckoned by some experienced workmen to be of considerable importance, is trifling in comparison with the facility of adapting the plane to all kinds of wood. By the aid of two thumb-screws acting upon a small lever, the iron is readily loosened or secured in any required position. Thus, the iron may be much inclined for planing soft and clear stuff, or set in a position much nearer the perpendicular when to be used on hard and cross-grained material. One tool may thus be made to serve in some degree the same purposes as a whole set on the present plan.

Burley's Dovetailing Machine.—A most ingenious machine for dovetailing has recently been invented and patented by Mr. Burley, of Boston. The main features of the machine are a platform upon which a sliding-table rests,

and four circular saws, which cut the entire pins and dovetails—doing away with the necessity of chisels, and performing the work in a manner which can not be done by hand. The dovetailing process, as is well known, has always been a most tedious and difficult task. Every joint had to be accurately marked out, and cut with a chisel by the hand; and in making the drawers of bureaus and other case-work, the expense has been very great. By Burley's machine, seventy-five to a hundred drawers can be neatly, substantially, and beautifully dovetailed in an hour. Better even, much better and stronger is the work than when done by hand, for the weary artisan is likely to slight some of his corners and finish in cutting the joints. The machine cuts the mortise with a precision and accuracy which renders every joint perfect. There is also a machine working on the same principle, and coming under the same Burley patent, designed for box dovetailing, the first invention being adapted peculiarly to cabinet-work and drawers. The main advantages of the machine are, that the operator can dovetail from eighty to one hundred boxes in an hour, and without extraordinary exertion, and yet the joints will be perfectly strong and neat. Hoops and nails in all kinds of boxes, however large, are dispensed with, and the packages for heavy goods are rendered quite as strong as if hooped with iron. All kinds of wood, whether clear or otherwise, are worked with equal facility. The advantages, therefore, of this machine in the manufacture of soap and candle-boxes, sugar-boxes, packages for dry goods, etc., can not be overrated.

Wait's Lathe for cutting irregular forms.—Mr. P. H. Wait, of Backersville, N. J., has recently patented an improvement upon Blanchard's well-known turning lathe—the first automatic machine ever made which was capable of producing an exact copy of an irregular pattern. The frame of Mr. Wait's machine looks somewhat like a saw-horse, for it consists of four arms, crossed and hung on a central shaft. The upper ends of the arms are furnished with revolving cutters, which bear against the stuff to be turned. The lower ends of the arms are made to embrace the pattern between them, being pressed up against it by means of springs. It should be observed that the frame does not revolve, but the arms move on the shaft, which serves as a pivot. When the pattern is made to revolve, the lower ends of the arms follow its irregularities, and thus correspondingly move the cutters to or from the stuff to be turned. There are two sets of cutters, and consequently two copies of the pattern are simultaneously turned. The chief advantages of this machine over Blanchard's and other lathes for turning irregular forms consist, first, in causing the guide-arms or pattern-followers to embrace the pattern, so that no matter how long and slender the pattern may be, it can never give way or bend. Second, in producing two copies of the pattern at once; or, in other words, doubling the quantity of work produced without any additional complication of the machine.

Wurth's Wood Lathe.—In this invention there are two sliding rests, one on each side of the stuff, which carry the cutting tools. The rests move slowly along the whole length of the machine, and, during their progress, are made to play in and out laterally, and so cause the cutters to act on the wood; this lateral play of the rests is produced by means of guide-plates located on

the sides of the machine. The guide-plates are of the same length as the stuff to be turned. The pattern produced in the wood is governed wholly by the formation of the guide-plates; the latter are so fixed as to be conveniently removed and others substituted. This is the only change required in the machine, to adapt it to the production of different patterns of turning. In its working, all that the attendant does is simply to swing the sticks and turn on the power. We have seen some elegant specimens of fancy turning by this machine. A lad, we are told, can easily attend to two of the lathes, and in one day do the labor of fifteen men working with fifteen hand-lathes.—*Scientific American.*

Improvement in Sawing Hoops.—Considerable difficulty has been hitherto experienced in pole-hoop sawing machinery to retain an even thickness in the hoops—cut off, as they are, from long, tapering, crooked poles. An improvement by Messrs. Strange and Smith, of Taunton, Mass., accomplishes this operation with an uncommon degree of perfection and rapidity. Two upright saws are arranged, side by side, and against them the hoop-pole is fed, by means of rollers. One of the saws, and one set of the rollers, are placed in a yielding frame, which readily expands or contracts, according to the irregularities of the pole. Two hoops, both of an even thickness, are cut by one passage of the stuff through the machine.

Portable Boring Engine.—The apparatus, which forms the subject of this invention, by Thos. Goodseem, of Providence, R. I., consists of a portable steam-engine, carrying one or more auger-stocks, either attached or geared with its main shaft. The cylinder of the engine receives steam from a boiler through a flexible pipe, which allows it to be carried about in the hands, and operated in different places at pleasure. The engine is also provided with a curious arrangement of sliding-pipes, whereby nearly the whole weight of the concern is supported by the pressure of the steam. In boring, therefore, the operator only requires to guide the augur by handles attached to the frame of the engine. If desirable, steam may be introduced, to cause the necessary pressure upon the tool. This is a singular improvement, applicable, we are told, with much useful effect in ship-building, and wherever large amounts of boring are to be done. Experience proves that steam may be conveyed with perfect facility in flexible pipes, for short distances around a stationary boiler.—*Scientific American.*

Improved Auger.—An improved auger, invented by J. W. Hoagland of Jersey City, N. J., consists in having the cutting portion of the auger made separate from the screw, and combining the two parts by means of a dowel and a screw in dovetail form. The object of this improvement is to allow of the screw part of an auger, which endures for a very long time, to be used for any number of the cutting parts, so that the latter can be renewed when required, if broken or worn out. For ship-carpenters the invention is of great advantage. A series of stocks may be made and marked with the letters of the alphabet. To each there may be several sizes of bits marked and adapted to fit accurately, and thus the carpenter, if supplied with a proper number of auger stocks and bits, will be able without loss of time to bore for any size of treenail. He will thus lose no time, as he now frequently does, in searching for a new auger, or getting a broken one mended, if he should break his

bit against an iron bolt. If he wishes to bore for new treenails of a different size from that which he has been using and boring for, he has but to unscrew his *bit* and put on another of a different size on the same stock, to bore a hole of a proper size.—*Scientific American.*

Improved Wood-Sawing Machine.—Mr. A. Winter, of Rondout, N. Y., has recently patented a wood-sawing machine for railroad or other purposes, capable of sawing more rapidly and with much less attendance than usual, and delivering the sawed material at any point desired. The wood may be separated in two or more places at the same time by simply mounting several saws upon the shaft; and one machine on this plan now in use on the line of the Reading Rail-road in Pennsylvania has proved itself capable of sawing and throwing upon the pile a cord in four minutes. It may be driven by either steam or horse-power, its principal peculiarity consisting in a series of belts or endless chains, provided with suitable hooks which carry forward the sticks at a moderate rate, present them to the action of the rapidly-revolving circular saw or saws, and then continue to carry them onward and drop them at the point desired. The belts or chains may be of any length desired, and so arranged as to elevate the wood to any required degree, the labor of the attendants being reduced simply to that of laying on the wood.

Machine for Sawing and Splitting Kindling Wood.—This machine for sawing and splitting kindling wood, invented by J. A. Conover of New York, is constructed as follows:—At the rear of the machine there is a circular saw which divides the sticks into suitable lengths, while at the front part there is a large splitting-ax, having four blades arranged at angles. These are attached to a vertical shaft, and move slowly up and down. Between the saw and the splitters there is a strong endless belt which receives the blocks of wood ends up, conveys them along toward the front till they come beneath the splitters. The stuff is here divided into kindling wood with great rapidity, and falls down in a pile at the base of the machine. The splitters have a very stately sort of movement, and when they enter the wood seem like spades acting on the soil, handled by some monstrous giant. We are informed that a man is enabled to cut up and split fifteen cords of wood per day with one of these machines.—*Scientific American.*

Straining Saws by Atmospheric Pressure.—Many attempts have been made to dispense with, and so save the power required to drive, the cumbersome sashes used in all saw-mills, by introducing an independent means of straining the saw-blade. In some instances steam has been employed; in others, air cylinders have been placed at each end of the saw, to which pistons, traversing the cylinders, were attached. The cylinders were exhausted by means of an air-pump employed for that special purpose, and the saws thus strained between the pistons. In an improvement recently patented by Brown & Coffin of Texas, the straining is accomplished in a similar manner, except that no pump or extra gearing is involved. A flat valve, opening outwardly, is placed in the bottom of each cylinder, which, by the alternate movement of its piston, opens and closes, thus producing the required exhaust or discharge. By this simple means the saw-blade is at all times kept evenly strained, by a yielding, self-adjusting pressure, which prevents the possibility of accident,

economizes the motive power, and saves trouble on the part of the operator.

Novel Machinery for Felling Trees.—In an arrangement patented by Thomas Durden of Montgomery, Alabama, no saw is used, the cutting being done by means of knives which project horizontally from an upright shaft. Rapid motion is communicated to this shaft by means of cogged gearing; there is also a connection between the gearing and a screw which feeds the cutters up toward the tree as fast as they enter; the feeding parts are therefore self-operating. The frame of the machine rests on a four-wheeled truck, so that it may be conveyed about from place to place with facility. The apparatus is firmly attached to the base of the tree by means of a pair of iron spurs; a hole is bored, the spurs inserted, and then wedged.—*Scientific American.*

Improved Boring Machine.—An improved boring machine recently patented by Messrs. Wyckoff & Morrison of Elmira, N. Y., consists of an auger, made, externally, in the form of a tube. The cutters are placed just within the periphery of the tube, at its lower end, so that when the latter is revolved a hole is bored and the auger enters the stuff, while the chips rise through its hollow interior. The outside of the tube is furnished with a spiral ledge or screw, which assists the rise and discharge of the chips. It is said that nothing can exceed the facility and accuracy with which pump logs are bored, and other species of work accomplished by the use of this improvement.

IMPROVED PLANE IRON.

In this improvement, patented by Horace Harris, Ontario County, N. Y., the cutting iron is placed inside of a thin metallic case, open at both ends. This case, with its cutter, is wedged into the plane in the common manner. The cutter is moved up and down within the case by means of a set screw. The thickness of the shaving is adjusted with the utmost facility; all that is required being simply to turn the screw. The improvement is cheap, simple, and applicable to the planes in common use.

IMPROVED BENCH-HOOK.

Bench-hook is the name given by carpenters to the little spur of iron against which they place one end of the stuff they happen to be planing, to prevent the same from slipping. Some carpenters drive in a nail at the head of their benches, and make it serve as a hook; others use a hooked spike. In both cases there is more or less trouble to lift the hook and set it to suit different kinds of work. An improvement patented by A. Hotchkin, of Schenevus, N. Y., consists of a small metallic frame, having in its center a pivoted tongue—like the tongue of a buckle; the frame is let in and fastened flush with the bench. The tongue serves as the hook, and as it may be instantly elevated or depressed by the finger, it manifestly possesses much advantage over the common hooks in point of convenience. The lower side of the tongue is notched, like a rack, and there is a spring pawl to match the same. This part of the contrivance is to hold the tongue firm in any desired position. —*Scientific American.*

IMPROVEMENT IN ADJUSTING BLINDS.

In an improved method of hanging and adjusting blinds, patented by Messrs. Sanger and Parker of Boston, the blinds, instead of being hung on hinges and made to open and close in the ordinary manner, are divided into two parts and caused to slide up and down in the window-frames, like the common window-sashes. By means of a simple application of cords and pullies, the blinds thus arranged are moved from within the apartment, thereby obviating the inconvenience of opening the window for that purpose. The blinds can be made to disappear in the casement when not wanted for use.

New Mode of Hanging Window-sash.—The following new method of hanging window-sash has been patented by D. A. Dunzaek, of Salem, Mass. The window-frame or casing is constructed in the usual manner for balanced sashes, viz., having boxes on each side of the frame. Within each box there is placed one weight, which has a pulley attached to one of its ends, around which passes a cord, which also passes over two other pulleys attached to each side of the frame at the center. One end of a cord is attached to the lower side of the lower sash, and the other end of it to the bottom of the upper sash. It is thus that both sashes are connected together by one cord and one weight on each side. The weights move without any jarring or noise. By the common method of hanging sash, a window requiring weights of 18 lbs. can be operated by the new method with weights of 8 lbs., thus saving 10 lbs. of iron. This improvement deserves the attention of all house builders.

IMPROVED FLOORING.

A patent has been recently granted to Mr. Groebl, of Philadelphia, for a new kind of wood flooring or marquetry. Mr. Groebl's floors are composed of small pieces of wood which fit together like mosaic, and are firmly connected with each other by means of tongues and grooves extending all around the single pieces. The pieces can be cut on Mr. Groebl's machine of any shape, either straight-lined or curved, so as to form any variety of patterns from the simplest figures of squares or diamonds to the richest designs with borders and corner-pieces. The single pieces being made of wood of different texture and color, a great variety in the general coloring of the floor can be attained. They require to be waxed once or twice a month like similar floors in use all over France and Germany; they are always clean and have a beautiful and graceful appearance, and are superior to carpets in many respects; they are excellent for the warm season and are the best floor for dancing. The price is about the same as oil-cloth or carpeting, and if manufactured on a large scale they could probably be got up still cheaper.

MACHINE FOR PEELING THE BASKET-WILLOW.

The cultivation of willows is a subject which has excited a good deal of attention in this country for a number of years. and many farmers have tried

it on a small scale, and found it very profitable; but owing to the great amount of labor required at one time to peel them, while the bark is loose, it was found that there could be but few raised in this country, where labor is so scarce and high, without there could be a power machine for peeling them. A machine to accomplish this end has recently been invented by George J. Colby, of Jonesville, Vt. The operation is simple, the willows being passed between two or three sets of India rubber rollers, one set of which has a vibrating motion, which rubs the bark off very effectually; the others mainly separating the willows from the loose bark. The rollers being made of India rubber, there is no possible chance for the willows to be injured, and it will adapt itself to all sizes, so that from 20 to 30 rods can be passing through at the same time. With one horse, and two men to attend it, it will peel from one to two tons per day, while to do the same amount of work by hand it would require 30 or 40 men and boys.—*Scientific American.*

IMPROVED METAL LATHE.

In an improved lathe arranged by Mr. Nasmyth, of England, for turning cast-iron pulleys for shafting, the slow motion for the mandrel is got by gearing down directly from an endless screw and a worm-wheel on the mandrel, the endless screw being driven by a belt from the shafting overhead, thus dispensing with the usual number of pulleys for reducing the speed of the shafting. The pulleys to be turned are bored and keyed upon a mandrel, of which there are a number provided of various sizes; the two centers of these mandrels being bushed with steel in a very ingenious manner. The slide-rest is made like an ordinary hand slide-rest, but the feed is given by a wheel and a T ratchet worked by a fine chain from a vibrating arm above, which is moved by a chain from an arm moved by a cam on the lathe mandrel; the chain can be hooked to any length, and so attached to the feed ratchet any where about the lathe.

NEW METHOD OF ENGRAVING ON GLASS.

One of the most ingenious devices recently invented is "Whipple's arrangement for engraving on glass." In this, the engraving to be transferred to the glass, is first cut upon a steel roller or cylinder. If the glass surface to be ornamented is a cylindrical one, as a goblet, this goblet and steel cylinder are mounted side by side in a lathe on spindles geared together, and the two are allowed to revolve rapidly, pressing with moderate force upon each other. Fine emery is then applied to both surfaces, and those portions of the steel cylinder which are in relief, by their continual pressing of the emery down upon the surface of the glass in the process of rotation, in a short time transfer in the most beautiful and perfect manner the whole device engraved upon the metal cylinder. The two rotating surfaces being accurately geared together, it is obvious that the same points on the circumference of each will accurately correspond in each rotation. If the surface to be engraved is a plane, the steel roller revolves by an arrangement of apparatus backward and

forward. In this way stone may be cut in relief in an exquisitely fine manner, and work which has heretofore required hours and days to accomplish, may now be executed in a few minutes.

RUGGLES'S ROTARY SHEARS FOR SHEET METAL.

A new tool, known by the above designation, has been lately introduced for cutting sheet metal, and which is made in sizes adapted to the thin tinned sheets or to the half inch boiler plate. One straight and one circular cutter are employed, the latter being revolved and slowly moved forward by the aid of a belt acting on a pulley at one extremity of the machine. The knives or cutters of this machine are so set that their edges do not come completely into contact, but only sufficiently near to ensure the separation of the sheet. It is found in practice with the ordinary lever shears that the cut invariably precedes the point of absolute contact of the knives, while it falls behind the point where the latter begin to press upon the metal. All shears compel the particles to slide past each other in the act of separation, and it is found that the cohesion of the metal is destroyed as soon as it fairly commences thus to slide, so that an absolute contact of the cutting edges in Ruggles's shears would be worse than useless. In practice the edges are set at a distance equal to half the thickness of the metal to be cut, and the sheets are divided with a degree of accuracy and of smoothness unsurpassed by any system yet devised.

IMPLEMENT FOR CUTTING WIRE.

An improved tool for cutting wire has been invented by Wm. Grover of Holyoke, Mass., Jr. It differs from the common knife-edged nippers only in the shape of its jaws. They are made round; in other words they are complete disks of steel, with holes of different sizes through their surfaces, for the reception of the wire to be cut. In its operation the handles are opened until a certain sized aperture in one of the disks comes in line with its equivalent opening in the other disk; the wire is then passed through and clipped by compressing the handles. The ordinary nippers are apt to bend the wire in cutting; they also leave a rough burr on the ends of the pieces. But with Mr. Grover's improvement, wire may be very rapidly cut to any size or length, without the least bending, and with perfect smoothness.—*Scientific American.*

IMPROVED SKATES.

Two patents for improvements in skates have been patented during the past year, by N. C. Sanford, of Meriden, Conn. The object of these inventions is to give the skate elasticity so as to enable a person to skate with more ease. Small tubes are placed vertically within the stock of each skate. In these tubes are placed india-rubber springs connected with knees secured to the runner, which is also thereby firmly attached to the stock, by which it gives some spring to the foot, and its use is thereby rendered more easy.

The second patent embraces the dividing of the skate, and connecting the two parts by a spring, and having the runner elastic, whereby the skate yields, and the back part rises with the heel, when the weight of the body is thrown upon the front part of the skate.

ENLARGING AND REDUCING MAPS AND DESIGNS.

James Murdock, of London, has taken out a patent for the purposes above-named. The invention consists in transfering a map or a design to a sheet of India-rubber in an unstretched state; then stretching the material equally in all directions, by having it secured in an expanding screw frame. This process enlarges the map or design. To make a design or a map smaller, it is transferred to the India-rubber sheet when it is in a stretched state, which is afterwards allowed to contract equally on all sides.

PROTEAN FOUNTAIN PEN.

The above designation has been given to a pen patented by Mr. N. A. Prince, of Brooklyn, N. Y. Protean is a word lately coined in Great Britain to designate one of the forms of hardened caoutchouc, from which material, under Goodyear's patent, this pen, or rather pen-holder, is manufactured. The handle is hollow throughout, and is filled with ink either by suction through the mouth or by the aid of a small piston, after which the top is tightly closed. The pen is attached in the usual way, but the ink-tube or handle is continued underneath and bent upward so as to shut its open end against the under side of the pen near the point. When pressed on the paper a sufficient opening is made for air to enter. In this position ink constantly escapes, while air enters at intervals and rises to the upper end of the handle. A small spring of protean fixed within the tube continually presses against the pen to serve as a conductor and prevent the possibility of the ink being driven back, while provision is made by suitable cavities near the base to catch any reflowing ink from the point, when the position of the pen is accidentally reversed, and prevent it from soiling the fingers of the operator.

IMPROVEMENTS IN LAMPS.

An improved entry lamp has been recently patented by Chas. W. Felt of Salem, Mass., the object of which is to effect a saving in light-producing material—gas, oil, or other burning fluid, used in lamps placed in entries of buildings (or situations where light is needed at short intervals), by reducing the light to the minimum burning point when it is not needed. The construction is as follows: the lamp is placed in a socket of a small metal plate, which plate is secured by screws to any wooden fastenings in the entry. The wick tube of the lamp has a small outer tube, which is capable of sliding up and down on it. When it is slid down, a greater portion of the wick will be exposed to the air, consequently the lamp will give more light; when it is raised a very small portion of the wick is exposed, consequently the light is

feeble. When a person enters the hall or entry where this lamp is placed, the door, as it is opened, is made to slide down the outer wick tube, so as to give greater light then, and by closing and opening the door again, the tube will be moved up to shield the wick, so as to save oil or fluid when a full light is not required. This principle of operation covers gas lights, and those obtained from burning fluids of any kind. The same operation applied to a fork on the cock of a gas pipe, will so operate it as to give a bright and feeble light by opening and closing an entry or hall door.

IMPROVED BASIN STOP-COCK.

In city dwelling-houses, where water is conveyed through the apartments in pipes, it is usual to furnish the wash basins with stop-cocks, the handles of which are hollow, and so arranged that when you pull the handle forward, the water discharges through it into the basin, and when you push it back the liquid ceases to flow. These stop-cocks, although ornamental and exceedingly convenient, possess, nevertheless, some defects. An invention by Mr. Eling of New York City, prevents the possibility of a careless overflow, by arranging a self-acting spring within the stop-cock, in such a manner that the water will run so long as you hold the handle in proper position; but the moment you let go, it flies back, and the water stops.

BRAMBLE'S AUTOMATIC GRAIN SCALE.

In this self-acting scale, a trough-shaped box, divided into two compartments by a partition running lengthwise, receives the grain from a reservoir placed above. The box rests on a weighing apparatus; the grain falls in a steady stream. When a sufficient quantity to balance the scales has fallen into the box, the latter cants over a little and shuts the spout, thus stopping off the grain; at the same moment a valve in the bottom of the box opens and the grain therein slips out, weighed and measured, into a bag; the box then tips back again, opens the spout, and receives a new load.

The whole apparatus includes in fact an elevator to continually carry up the grain to a reservoir or bin, as well as the measuring apparatus for letting it down. The first process, the elevating, requires steam power; but the latter, the measuring, does not, the whole movement being effected in this case by the gravity of the descending grain. This machine weighs off the grain, indicating the amount by a dial, and may be set to weigh any desired number of bushels, stopping itself when the number is completed. The whole affair is extremely simple, containing no delicate members except in the scale-beam where the weight is indicated. The quantity weighed at each draft is three bushels, and five drafts are taken per minute, so that it is practicable to weigh off with accuracy nine hundred bushels per hour. The point wherein this scale differs from all other attempts by the same and other inventors is in checking the flow of grain before the weight is completed. It has been found that a large stream of grain rushing with rapidity into any scale, exerts a considerable force by its momentum in addition to its gravity, and it is difficult to calculate and

compensate for this influence. The present scale receives the grain in a large stream until the proper weight is nearly attained, then by closing the principal gate and receiving a small stream finishes the operation with all the nicety desired.

FILE-MAKING BY MACHINERY.

For the last 20 years skilled mechanics have exerted all their ingenuity in trying to discover a process of manufacturing files, so as to lessen the cost of production. Some firms in Sheffield and elsewhere are said to have spent fortunes in experimenting, in the hope of attaining this end, and have still failed. A machine, which has proved successful, has recently been invented by Mr. Ross, of Glasgow, Scotland. The merit of the invention will be best understood by the general public, when it is stated that by its agency files can be struck, and that in a superior manner, with an advantage in labor alone of at least 200 per cent over the old process of hand-striking. A skilled file-cutter will strike by the hand somewhere about twenty common 40 inch flat bastard files in a day. One of Mr. Ross's machines, under the direction of a boy, will strike sixty files in the same amount of time. The machine is so simple too, that an uninitiated boy can in a few hours be instructed to attend it. A one-horse steam-power is capable of driving six of these machines, and with some practice, a lad might be able to attend two of them, for they possess the attribute of stopping of themselves when a certain portion of work has been completed. A comparative glance at the hand-made and machine-struck file at once shows the superiority of the latter, even were the other advantages altogether kept out of view. Flat bastard or equaling files, common and tapered, are those most in use, and are the kind which Mr. Ross's invention has been mostly hitherto engaged in producing; but the machine can be modified to strike rounds and all the other variety of files. As was to be anticipated, the machine-made files have already found their way extensively into use, although only a few months have expired since the process of manufacture was begun.—*North British Mail.*

CARPENTER'S ROTARY PUMP.

A pump recently invented by Mr. S. D. Carpenter, of Wisconsin, is worthy of attention from the simplicity and at the same time singularity of its motions, the fewness of its parts, its small cost of construction, its economy of space, and evident durability. The whole pump consists of a metallic case, in which is inclosed a vertical shaft with a nearly hemispherical mass of metal at its lower extremity, and a vibrating or oscillating feather. When impelled by a continuous power, as in filling up tanks at rail-road stations, the shaft may be safely driven with considerable velocity, and the pump may be considered tolerably perfect without the aid of any packing. It is questionable whether the rotary motion is easier than the reciprocating for pumps worked by hand, but where power is employed for the raising of considerable quantities, the invention of this pump renders it unnecessary and highly impolitic to convert the rotary motion of the shaft into any kind of a reciprocating action.

The pump for general purposes is manufactured entirely of cast-iron. The lower portion of the case is spherical, and is closely fitted by the spherical side of a casting at the foot of the shaft, which shaft, in this case, is assumed to be vertical. This casting is nearly a hemisphere, the top being somewhat conical instead of flat—the general form of the casting approximating to that of a boy's spinning-top inverted. Imagine this nearly hemispherical mass sawed nearly in two by a vertical cut commencing at the apex, and insert in the opening thus made a semi-circular disk of metal, straight side uppermost. This disk will represent the feather alluded to. Lay a flat cover upon the point of the cone and incline it until it bears fair upon the inclined surface of the cone. This cover will represent the flat side of the nearly spherical case, and a rude model of Carpenter's pump will be the result. On revolving the internal mass by the aid of a shaft continued upward from the point of the cone and passing out obliquely through a stuffing-box in the flat side of the case, the feather will oscillate so as always to bear with its straight edge against the flat side of the case. A screw at the base allows of driving up the whole shaft, and with it the sector of a sphere described, to compensate for any wear of its upper surfaces; and as this driving upward of the interior work would increase the space below and make a leak at that point, provision is made for preventing this by a very simple modification of the form of the parts, which insures a tight joint at the largest part of the pump in all cases; and to prevent any flow of water through the slot in which the feather acts, the slot or split is not made continuously across, but is interrupted in the middle by a solid partition, and a triangular portion is cut from the feather to correspond thereto and allow of its free vibrating motion.

Gray's Improved Pump.—In this pump, invented by S. H. Gray, of Bridgeport, Conn., two pistons are employed in one cylinder, both operated by one handle or lever. The improvement consists in a novel means of operating the pistons. A shaft passes transversely through the center of the pump-barrel, within which, on the shaft, a cogged pinion-wheel is placed. The piston-rods have teeth on them like a rack, and gear with the pinion. Outside of the pump, and attached to one end of the shaft, there is a handle or lever, by working which back and forth, the pistons are operated. No piston-rod, it will be noted, is seen on the outside, since all the moving parts, except the lever, are confined inside of the pump. By the use of this invention two separate streams of water can be discharged, if desired, or a single continuous one. It is, in effect, the combination of two of the ordinary pumps into one apparatus, at a cost which exceeds only by a trifle the expense of the single pump. The prominent advantages are, doubling the capacity, and therefore the utility, without much increasing the cost.—*Scientific American.*

BROAD-CAST MANURE DISTRIBUTER.

The object of this invention, which has received a prize from the Royal Agricultural Society of England, is to distribute regularly all kinds of natural and artificial manures, even the most difficult ones used as top-dressing, such as nitrate of soda, salt, guano, and soot. The manure is delivered from

the box by means of a barrel of novel construction, consisting of a shaft fitted with prongs, which carry over the manure, and in doing so, comes in contact with a series of scrapers which rise with and clean the barrel as it rotates, without the aid of brushes, sweepers, or any other perishable material, from whence it passes down the shoot or conductor, and is evenly distributed all over the surface, or in three or more rows. The shoots or conductors are furnished with wire rods, fixed in alternate lines, giving them the effect of a sieve, whereby the manure is separated and pulverized as it falls.

WILSON'S IMPROVED WHEEL-BARROW.

In this improved wheel-barrow (an English invention) the wheel or "trundle" is placed under, and is recessed into the bottom of the barrow, the internal projection being covered over by a piece of curved sheet-iron, boxed in with side-pieces. With this position of the wheel the weight of the contained load is thrown upon the wheel instead of being carried between the hand and the wheel, as in the common barrow, thus relieving the laborer's arms. The sinking of the body over the wheel also brings the weight nearer to the ground and diminishes the working oscillation. The handles are attached quite separately from the body, and they are set on at a considerable angle so as to reduce the lift in wheeling. Where nicety is required in wheeling, as in going over a plank, a brass knob is set on the top of the front board, at the middle, so as to be directly in the line of the wheel and serve as a guide; and to prevent the dirt from clogging the wheel-cover, a scraper is attached behind the wheel.

IMPROVEMENTS IN EARTH-BORING MACHINERY.

At a recent meeting of the London Society of Arts, Mr. Colin Mather read a paper on "Earth-Boring Machinery," and some recent improvements effected in the same. Among the various systems which have been adopted, one well-known method of boring, is to attach a chisel to a series of rods which are suspended from the end of a spring-pole. When the debris has accumulated so as to obstruct the progress of the chisel, the rods are withdrawn by means of a windlass, each one being separately unscrewed as it is wound up. A tubular instrument of sheet-iron, called a shell, usually from 3 to 4 feet long, and something less in diameter than the size of the hole, with a clack at the bottom, is then substituted for the chisel, and the rods are screwed together again and lowered. Another method generally resorted to, when the weight of the rods is so great as to overcome the elasticity of the spring-pole, is that in which a rope is substituted for the rods, the impulsive motion being obtained by coiling the rope several times round a windlass, and then suddenly slacking it. A third method is that invented by M. Fauvelle. This apparatus consists of wrought-iron tubes, screwed end to end, the lower one being armed with a cutting tool somewhat larger in diameter than the tubes, so as to leave an annular space around them, up which the water and excavated material are forced, by means of a column of water sent down the tubes by a force-pump.

Having thus briefly described some of the methods in general use, the author next proceeded to explain a machine he had invented, in which the construction of the boring-head and the shell-pump, and the mode of acquiring the percussive motion, constitute the chief novelties. The boring-head consists of a wrought-iron bar about 8 feet long, upon the lower part of which is fitted a block of cast-iron, in which the chisels, or cutters, are firmly secured. Above the chisels an iron casting is fixed to the bar, by which the boring-head is kept steady and perpendicular in the hole. A mechanical arrangement is provided, by which the boring-head is compelled to move round a part of a revolution at each stroke. The shell-pump is a cylinder of cast-iron, to the top of which is attached a wrought-iron guide. The cylinder is fitted with a bucket similar to that of a common lifting-pump, with an India-rubber valve. At the bottom of the cylinder is a clack, which also acts on the same principle as that of a common lifting-pump, but it is slightly modified to suit the particular purpose to which it is here applied. The bottom clack is not fastened to the cylinder, but works in a frame attached to a rod which passes through the bucket, and through a wrought-iron guide at the top of the cylinder. The percussive motion is produced by means of a steam-cylinder, which is fitted with a piston of 15 inches diameter, having a rod of cast-iron 7 inches square, branching off to a fork, in which is a pulley of about 3 feet in diameter, of sufficient breadth for the rope to pass over, and with flanges to keep it in its place. As the boring-head and piston will both fall by their own weight, when the steam is shut off, and the exhaust valves opened, the steam is admitted only at the bottom of the cylinder. The exhaust port is a few inches higher than the steam port, so that there is always an elastic cushion of steam of that thickness for the piston to fall upon. The valves are opened and shut by a self-acting motion derived from the action of the piston itself.

The following facts, obtained from the use of the machine, in boring in the new red sand-stone at Manchester, show its actual performance. The boring-head is lowered at the rate of 500 feet a minute; the percussive motion is performed at the rate of 24 blows a minute, and, being continued ten minutes, the cutters in that time penetrate 5 to 6 inches; it is then wound up at 300 feet a minute. The shell-pump is then lowered at the rate of 500 feet a minute, the pumping continued for one minute and a half, and, being charged, the pump is wound up at 300 feet a minute. It is then emptied, and the operation repeated, which can be accomplished three times in ten minutes at the depth of 200 feet. The whole of one operation in the deepening of the hole 5 to 6 inches, and cleansing it of debris, ready for the resulting cutters or boring-head being again introduced, is seen to occupy an interval of twenty minutes only. The value of these facts will be best shown by comparing them with the results by the old method. At Highgate, the boring has occupied two years in attaining a depth of 680 feet from the bottom of a well 500 feet deep from the surface. Their progress at present is at the rate of 6 inches per week, working night and day. At Warwick, thirteen months were occupied in boring 400 feet through red marl; at Saltaire, two years in going 80 yards. By the new machine, the work at Highgate could have

been done in 33 days, that in Warwick in 20 days, and that at Saltaire, to supply the work-people with drinking-water, in 29 days.

IMPROVEMENTS IN WRENCHES, VICES, ETC.

Self-Adjusting Screw-Wrench.—The distinctive feature of an improved screw-wrench recently patented by Mr. A. Hotchkiss of Sharon Valley, Conn., consists in the extreme facility with which it is adapted to different sized bolts and nuts; the movement being accomplished with ease by pressing with the thumb upon a projection on the movable portion of the wrench. The bar is hollowed on the front side, and armed with cross grooves which transform it in fact into a portion of a nut. A loose hollow screw, or rather a threaded thimble, is attached to the movable jaw and fits accurately into the grooves described, being pressed into contact by a concealed spring. The strain on the wrench when applied to use tends to force the screw into still closer contact with the grooves, so that all possibility of slipping is avoided, while at any moment a gentle pressure on the projection raises the screw out of contact and allows of its being shifted. If greater accuracy of adjustment should be required, it is obtained by revolving the screw or threaded thimble. The movable jaw is of malleable iron. The hollow screw is fitted on a nicely-turned projection on the jaw. The bar is of wrought-iron, forged in one piece and case-hardened; the whole constituting one of the strongest as well as most convenient screw-wrenches in existence.

Improved Wrench.—A novel device for a wrench has been patented by Alden Graham of Roxbury, Mass. Two nearly straight pieces of steel are attached, by pivots through their centers, to the end of a suitable handle, and form the jaws by which the nut to be turned is seized. The jaws are placed at right angles to the handle, and are hung in a slot in the latter. The backs of the jaws are furnished with screw threads, and are encircled by a corresponding screw ring, by turning which the ends of the jaws may be opened or closed at pleasure, and thus adjusted to suit any size of nut. There is a ratchet arrangement which permits the turning of the nut without removal of the wrench after the jaws have been adjusted.

Improved Machine Punch.—An improved attachment for a machine punch was exhibited at the Fair of the American Institute. It consists in a slight handle for stopping, or rather for starting the motion. The toggle-levers which work the punch are of such length that a wedge-like piece is required to interpose between them and the head of the punch, in order to render the movement effective. A small hand-lever controls this wedge, keeping it constantly withdrawn except when touched by the operator. The result is that the workman takes as much time as he pleases in adjusting the metal to be punched, instead of placing it hurriedly and often imperfectly, as in the old plan.

Improved Vice.—A patent for an improved vice has recently been issued to R. W. Davis of Yellow Springs, Ohio, in the construction of which the movable jaw is furnished, near its base, with a guide-piece, which passes through a slot in the fixed jaw: the latter acts also as a guide, which passes through the

movable jaw. Between and attached to these guide-pieces are a pair of cross levers, or connecting rods, so pivoted and arranged that when the screw which operates the vice is turned, the movable jaw will always retain a position exactly perpendicular to that of the fixed jaw. All mechanics know the importance of keeping the two jaws thus in agreement. It allows a firmer hold to be taken on any substance placed between, relieves the screw of friction, and prevents the tendency of the vice to become weakened or soon to wear out. There are several different kinds of vices arranged with a view to accomplish the above purposes. The invention of Mr. Davis is intended to be considerably cheaper in construction, and, if possible, more effective in its operations than any of them. Only one screw is employed and no nut is required to be sunk in the movable jaw.

IMPROVED DOOR-LOCK.

At the recent Fair of the American Institute Mr. W. H. Baxter of N. Y. exhibited an improved door-lock, combining the safety of a bank-lock with the simplicity of a latch-string. It opens from the inside by a simple pull on the knob without straining or soiling the most delicate kid. On the street side the key-hole is a narrow slit hardly large enough to admit a fine wire, and the key is a small plate of thin metal thrust in directly without turning. The end of the key is shaped into rectangular notches of unequal depth, and presses upon six or more tumblers, each of which must be depressed to a certain depth before "the bolt" will move. Strictly speaking, no bolt is employed in this lock, the fastening being made by a strong horizontal wheel of small diameter, containing a large cavity, which embraces a corresponding fixture in the door-frame and holds on to it firmly. It is called the rotary lock, and appears the strongest, the most easily operated with a key, and the most difficult to work without that appendage of any we have ever examined. The key is about the size and thickness of a two-shilling piece.—*New York Tribune.*

IMPROVED BRICK MACHINE.

At the Fair of the Royal Agricultural Society at Carlisle, England, a brick machine involving some new principles was exhibited by Messrs. Porter & Co. This machine, which was capable of turning out 18,000 bricks per hour, effects the two processes of grinding and molding the clay simultaneously. The grinding mill is horizontal, having two shafts, on which are placed two cylinders, with a series of knives cast on each. It is fed with tempered clay, which it thoroughly commingles and propels by means of the splay given by the knives to the rollers, which are supplied through a chamber at the end of the mill. These rollers force the clay through a die of hard wood or gun metal of suitable dimensions to form the sides of the bricks. As the clay is thus propelled in a solid and consistent body, it moves upon small rollers until it comes within range of the cutting apparatus, which is a contrivance of six wires attached to a frame sliding upon friction rollers. This frame is moved suddenly backward and forward by the hand, separating the clay into five

well-formed bricks at each stroke. The bricks are cut in the direction of their bed, so that the four sides are preserved smooth, while the top and bottom are slightly roughened, an effect which, with the perforation of the center, secures the proper adhesion of the mortar, and consequent safety in building.

STRENGTH OF GUTTA PERCHA TUBING.

Some interesting experiments recently made in Boston show an almost incredible strength in gutta percha tubing and its value above other materials for water-pipes, etc., where power to resist great pressure is required. A pipe half an inch inside diameter stood 370 lbs. to the square inch, and burst at 390; a five eighths inch pipe (the kind made for service pipes for the Boston water works) stood till 580 lbs. of pressure to the square inch was applied; but a quarter inch pipe, made for soda fountains, stood uninjured the great pressure of 1,000 to the square inch!

IMPROVEMENT IN THE CONSTRUCTION OF WINDLASSES.

In the operation of almost every species of ships' windlasses or winches, it is necessary to apply the rope to be heaved at right angles to the barrel of the windlass; otherwise the rope would not wind easy or even. For this purpose temporary guide-posts or pulley-blocks are usually rigged, which, of course, are more or less inconvenient, troublesome, and in the end expensive An invention by W. N. Gesner of Fair Haven, Ct., provides a frame of iron or other material, which is attached to the ends of the windlass shaft, just like the bail of a kettle on a large scale. The guide-block is attached to the center of the frame. The latter, it is apparent, will always be on hand when wanted, and never in the way at other times, for it can be thrown up or turned down for use instantly, at pleasure.

IMPROVEMENTS IN THE MANUFACTURE OF HATS.

In the ordinary manufacture of hat bodies, several different kinds and qualities of fur stuffs are used, the desired proportions of each being weighed by the hand, and then carried to a machine, where the fibers are loosened, cleaned, and thoroughly mixed together. At this stage of the process the material is removed and dealt out, by hand weight, into small quantities, just sufficient for single hat bodies. Each quantity is now separately passed through another machine, where the mixing and cleaning operation is completed, and the stuff thrown by blast upon the hat former. In a machine invented by Messrs Annesen, Pedereen, and Rees, of New York, the mechanism is so arranged as to receive the raw material at one end, and deliver it at the other ready made up into perfect unfelted hat bodies; all the various operations of selecting the desired qualities of each kind of stuff, mixing, cleaning, and weighing off the proper amount for each body, being done in the machine, without being touched by hand from first to last. It would require drawings in order to convey a clear idea of the various parts. The invention

is one of ingenuity and importance. The quality of work it turns out is said to be better than that done by the ordinary process.—*Scientific American.*

IMPROVED CLOCK ESCAPEMENT.

An improved escapement, patented by E. K. Reynolds, of New York City, is more particularly designed for clocks and other time-keepers, which are intended to run a long time without winding; on account of its very slow movement it is particularly suited to year clocks. It consists in an escapement lever, whose point works in a spiral groove or screw thread, in or upon the staff of the balance; the latter is arranged perpendicularly to the arbors of the lever and escapement wheel. It is a very ingenious but simple improvement, adding but very little to the expense of a time-piece, although greatly increasing its convenience. Applied to a common one-day clock, the latter will run a week without winding; while an eight-day piece will only require to be wound once a month. Year clocks, we are told, can be produced with equal facility.—*Scientific American.*

IMPROVEMENTS IN MUSICAL INSTRUMENTS.

Improved Pianoforte Action.—In all pianoforte movements, one of the most important requisites is such an arrangement and connection of the keys with the hammers as will permit an easy and perfect repetition of the same rate. An invention recently patented by Mr. John S. Merlin, of New York, designed to effect most perfectly this desired end, consists in the peculiar application of a lever to the jack, in combination with a block attached to the hammer, whereby, after the hammer escapes, it is caught at a short distance below the string, and held in readiness for a free and rapid repeat; whereby also, the return of the point of the jack into the notch of the hammer butt is facilitated.

Wind Regulator for Organ Pipes.—In church, and other organs, the throats or lower parts of the music-pipes rest on a box called an air-chest, into which the air from the bellows first flows. Holes are made through the air-chest, and into them the pipes are placed to receive wind. The tone of each pipe is set or tuned by altering the size of its throat. If the sound is too low, the throat is jammed together a little with a hammer; if too shrill, it is enlarged with a mandrel. An invention, recently patented by Daniel George, of Nazareth, Pa., consists in simply placing a common stop-cock in the throat of each tube—an improvement which permits the tuning of the pipes with the utmost convenience and perfection.

Driggs's Improved Pianos.—Mr. S. B. Driggs, of New York, who has occupied himself many years in considering the structure and capabilities of the pianoforte, claims to have made several improvements, as follows:

1. To have arranged the strings so as to secure a tone clear of harmonic vanishings, and hence purer.

2. To have added an *attachment*—in this case metallic forks—which, subject to the action of a third pedal, affords a new and agreeable sound. This is not

a continued sound, but short and crisp, like a musical-box, and capable of being mixed with the ordinary tone. It has been played upon at a concert and much admired, the pieces being encored.

3. By a certain disposition of the strings, Mr. Driggs enables the two strings, giving to each one note, and tuned accordingly in unison, to be tuned together by a single and easy turn of the tuning-fork. This is certainly a great improvement. It lessens the labor of tuning the piano, and secures a more complete accordance in the hands of most tuners. It must take the place of the old piano in use.—*New York Tribune.*

MISCELLANEOUS INVENTIONS.

Ornamenting Wood.—Thomas Clayton, of Oldham, England, has obtained a patent for transferring the designs of graining on choice wood, such as mahogany, rosewood, yew, etc., from engraved metallic heated rollers, or flat surfaces, to the surfaces of common woods, such as pine, whereby a close imitation of choice and expensive woods is produced.

Marbleizing the Surface of Stone.—Mr. J. Claudot, of Paris, has recently obtained a patent for covering the surface of common stone or plaster of Paris figures with a coating of marble, as follows:—He lays upon the surface of the stone successive coats of milk of lime, allowing each to dry before the other is put on. When these coats have attained to a proper thickness; he smooths them down and polishes them until the surface resembles marble in brilliancy. Carbonic acid is then applied upon the outer surfaces, when it becomes real marble. The milk of lime may be colored so as to produce the exact appearance of variegated marble.

Arrangement for Washing Windows.—A useful and novel arrangement for washing windows has been invented by G. A. Meacham, of N. Y. It is perhaps the first attempt to reduce to an exact science the principles of this sloppy, sploshy, and intrinsically hateful operation. An oil-cloth protection is stretched on an extensible frame across the window-sill, to catch the drippings, and a sponge filled with clean water is applied by a pole to every portion of the glass surface. The sponge is kept wet by a small hose-pipe of India rubber, which leads up to a pail previously suspended at a higher level, and the operation is completed by removing the sponge and allowing the water to flow through a nose and rinse off the last remaining particles.

Freeing Canal Boats from Water.—An invention of William Loughridge, of Weverton, Md., has for its object the discharge of the leakage from canal boats and other vessels without the employment of pumps. It consists in the peculiar arrangement of a float in the interior of the vessel combined with a tube operating on the syphon principle, by which the discharge is rendered automatic, and the vessel freed from its leakage at all times, without the assistance of the crew, rendering examinations as to the quantity of water made unnecessary, and obviating the necessity for a watch to pump out during the night.

Absentees' Register.—The Boston *Medical Journal* notices the invention of a useful little contrivance called the *Absentees' Register*, for indicating the hour

when a person absent from home may be expected to return, which is very convenient for medical men. It consists of a small plate of metal, on the back of which two discs are made to revolve. On the circumference of one disc are printed the hours in Roman numerals, the other contains the minutes in Arabic characters. By turning the discs every hour and minute may be shown, by bringing them opposite two apertures in the metal plate.

Machine to record the Beatings of the Pulse.—In a machine for the above purpose, invented by Professor Bierordt, Frankfort, Germany, the arm of the patient is placed in a longitudinal cradle, and screwed down sufficiently to keep it steady. A small erection on one side holds a sort of lever worked on a hinge, at the end of which a pencil is inserted, the point of which has been dipped in Indian ink. This goes into a cylinder upon which paper has been stretched. The lever rests upon the pulse, and at every moment records the action upon the paper. If the pulse is steady a regular, zig-zag line is drawn on the paper, but in cases where the pulse is rapid and jerking, the line goes up and down, making long and uneven marks.

Japanning Leather.—A. V. Newton, of London, has secured a patent for opening the pores of leather, by impregnating it with sulphur, for the purpose of preparing it for enduring a great degree of heat, and for toughening its fibers. The sulphur is combined with varnish, and any gum-elastic solution may also be combined with it.

Bearings for loose Pulleys.—The object of this invention of Messrs. Campbell & Shippen, patented October, 1854, is the placing of a loose pulley and hanger beside a driving pulley on a line-shaft, or on any intermediate shaft bearing the same relation to a lathe or other machine, to be detached as a line-shaft, whereby is obviated the continual wear attendant upon the loose pulley, shafting, and belts, when a lathe, or loom, or other machine, driven in from the line of shafting is not running. The loose pulley and hanger having an axis, may be made to revolve independent of the shaft. The improvement obviates the necessity of throwing belts off the pulley in order to prevent the wear of machinery while the engine is in motion, also making it more safe for the operatives.

Machine for Trimming Books.—Few substances are more difficult to cut, with a smooth, true edge, than sheets of paper laid together in quantities. Printers and bookbinders have always experienced the truth of the fact, although many an inventor has studied hard to relieve their troubles from this cause. Complete success, however, has never been reached. Many ingenious devices have been made, but nearly all of them fall short of the mark, in one way or another. Mr. Riehl, of Cincinnati, claims for an invention recently patented a superiority over all others. The sheets of paper to be severed are laid on a table, the knife is attached to a crank arrangement and pitman, in such a manner that by turning the crank the knife-edge is forcibly drawn across the paper and the cutting thus effected. This drawing movement of the knife is the peculiar feature.

Improvement in Screw-Fastenings.—This invention of Loudon & Ahlstrom, of New York City, relates to expanding screw-fastenings, to be used under conditions in which bolts and nuts of the common construction are not appli-

cable. It consists in a method of constructing either a bolt-head or a nut, as the case may require, whereby the screwing up of the nut or the bolt causes it to expand, and makes it fit tightly within any opening or hole within which it is inserted, and so wedges it in that it can not be directly drawn out.

Uncorking and Decanting Machine.—This consists of a neat little ornamental metal stand, carrying an inclined rest for the reception of the bottle during the process of uncorking. At the part where the bottle-neck projects over the frame-standard is a cork-screw, which steadily withdraws the cork from the neck. Clamped in position upon the frame, and all strain being within the frame itself, no shaking can ever arise. When the cork is out the butler tips up the holding rest, with the bottle with it, to the required angle for decanting the contents, without disturbing the crust or sediment.—*London Practical Mechanics' Journal.*

Improvement in Water-Pipes.—Mr. Waite, of Leeds, England, has patented water-pipes formed internally of white delf, with a glazing like that of porcelain, and surrounded and compacted with a thick covering of a sort of concrete, forming a strong and impervious substance not liable to decay, and as capable of resisting violence as iron-pipes, and more economically produced. They are also said to be well adapted for gas-pipes, and to be so air-tight as to prevent leakage.

THOMPSON'S IMPROVED LIFE-PRESERVER.

This invention, by Mr. Nathan Thompson, of New York, is designed to serve the purpose of a seat on all ordinary occasions; but, unlike the other forms of life-preserving seats, when employed as a preserver, it encircles the body like a belt, and may be supposed capable, if perfectly tight, of sustaining the body not only after the hands are too weak or numb to grasp one of the ordinary kind, but even after life is extinct; and the skeleton of the lonely voyager may be supposed to drift backward and forward until a storm should wash it from its secure position. Although the latter stretch of imagination may not of itself be particularly soothing to the nerves, the superiority of such a device over the ordinary canister-shaped seats can not well be questioned. Thompson's is in fact a species of double box, the halves being hinged together in such a manner, that when folded together it forms a compact seat, and when extended, produces a kind of rectangular float, with a sufficient aperture in the center to admit the body of a stout man. It this position, with the arms hanging over the sides, the support would be much better and more prolonged than by any method of grasping the legs of a stool.—*New York Tribune.*

IMPROVEMENT IN TAILORS' MEASURES.

An improvement in tailors' measures has been recently patented by John M. Krider, of Middletown, Va. Various instruments for taking the measure of persons, in order to cut the cloth accurately for garments, have been used; but these, it is stated in the patent of Mr. Krider, have been defective, "by depending on the judgment in contracting the curved admeasurements, such

as that arising in measuring from the arm-pit to the collar and back seam, wherein the tape measure has two directions to give the curve, which must be uncertain when laid on the cloth as a plane." The object of this instrument is to secure a proper measure, independent of any exercise of the judgment, simply by an application of it to the body; and, after the several measures are taken from fixed points, all of them can be transferred to the cloth. The lines, measured over a curve on the body, are flattened and applied to the cloth on a plane, and these are made to occupy the same place on the body in the coat as when measured by the instrument, thereby insuring perfect accuracy of fit.

GAS REGULATORS.

A patent has been granted in England for an apparatus for regulating the supply of gas to the burners, consisting of a cast-iron vessel, with inlet and outlet passages, for the admission and emission of the gas. The inlet passage is covered by a valve—the edge of which dips into a groove containing mercury, rendering it perfectly gas-tight, without impeding the motion of the valve, which moves with the slightest pressure. It is attached by a rod to a short cylinder, the lower part of which is open, and also dips into mercury. This cylinder covers and surrounds the inlet, and, as the gas flows through it, exerts an upward pressure, which adjusts the supply. If the pressure is increased, the cylinder rises and closes the valve; and, as the gas is consumed, the cylinder falls and opens the valve.

In another arrangement, also recently patented in England, the regulation is effected by a slide, or disc valve, formed by two corresponding surfaces, placed together between the inlet from the main and the outlet to the burners. The supply is increased or diminished by the continuous opening and closing of the passages in this valve, which movements are effected by the variable pressure of the gas within a small gasometer, which, as it is greater or less, increases or diminishes the area of the supply passages, and thus regulates the supply to the burners.

A regulator, invented by Mr. S. P. Parham, of Trenton, N. J., consists of a chamber into which the gas enters through a nipple at the bottom, and from which it passes to the burner through an opening above. This chamber contains an inverted cup to cover the nipple, and a conical valve to fit the opening at the top, the valve and nipple being attached to the same stem. The cup is larger than the nipple, and the top of the latter is serrated, so that the gas can always escape freely into the cup and down its sides to enter the chamber. The entrance to the passage, which forms the seat of the valve, is made slightly elliptical, so that it never can be perfectly closed by the valve. The cup, the valve, and the stem, are all made of such thin metal as to be light enough for the gas, as it is passing through the chamber to the burner, to suspend them. The flow or consumption of gas is regulated by the position of the valve, which will be so controlled by the relative pressures in the chamber below and the burner above, that the area of the opening between the valve and its seat will always be proportional in the inverse ratio to the

pressure of the gas in the pipes. An increased pressure of the gas in the pipes and chamber raises the valves, and contracts the opening, a diminished pressure causes the valve to drop, and the opening to be enlarged.

In a patent granted during the past year to Palmer and Woodruff, of New Haven, Conn., for gas-regulators, the apparatus has two cylinders, one arranged within the other, and having communication all round the bottom, making them equivalent to an inverted syphon. There is a space between the two constituting an air-chamber, having communication with the atmosphere through two small tubes at the top. The interior of one cylinder is the gas-chamber. This chamber is always filled with gas, and the pressure is the same as in the pipe. The valves of the inlet and outlet tubes are conical, and close downward; they are attached to a rod which has a float on it, resting on the water in the lower part of the gas-chamber. The gas and air-chambers are filled with water to such a height as to give the valves a full opening when the burners are all open and the pressure lowest. As the pressure in the pipe tends to increase by pressure on the main, acting on the inlet, or by shutting off some of the burners, acting on the outlet, the pressure in the gas-chamber increases, and acts on the surface of the water, depressing its level, and forcing it into the air-chamber, when the float of the valves falls, and contracts the gas-openings. When the pressure of the gas diminishes, the contrary effect is produced, and thus the pressure in the pipe which supplies the burners is rendered uniform.

WEIGHT OF COAL.

A recent decision of the United States Circuit Court of Philadelphia establishes the weight of a ton of coal at 2,240 lbs., instead of 2,000 lbs. The judge ruled that a company of grocers might as well meet and agree to reduce the number of ounces in a pound, and make the smaller number the standard of a pound for their customers, as for coal-dealers to agree that the weight of a ton shall be 2,000, and furnish that amount to their customers.

DEDERICK'S IMPROVED HAY-PRESS.

A curious fact in relation to rail-road economy has recently been stated, namely, that there are at present more horses employed in connection with the different rail-road companies in New York City, than were used twenty years ago upon all the stage routes directly leading to the city. This greatly increased number of horses within New York has also occasioned the consumption of a vast additional amount of hay, nearly all of which is brought to market in a pressed and baled condition. This in turn creating an additional necessity, has required a better and more efficient form off hay-press than was formerly used. An old-fashioned hay-press required a separate and entire building for its accommodation, and was an expensive and inconvenient machine. This has, however, been superseded by a press invented by Mr. Levi Dederick of Albany, N. Y., which appears to combine all the advantages desired. The main improvements in this press relate to the arrangement of the

doors and of the "follower," giving to the latter a parallel motion while pressing, by means of toggle-levers. A clear explanation of the principles of the press can not be given without engravings, but it is sufficient to say that the press is portable, easily taken down and put together, and inexpensive. In short, a farmer, instead of being obliged to build an expensive structure as formerly, can now order a hay-press with as much facility as he can a reaping-machine or a horse-power.

THOMPSON'S CIRCULAR SELF-ACTING GATE.

A patent has been recently granted to William Thompson of Nashville, Tenn., for an improved peculiarly self-acting gate. The invention relates to gates for farms, parks, and inclosures of any kind, and consists in constructing the gate of a circular form like a wheel, and allowing it to rest, when closed, on a vibrating rail which is operated by a person, wagon, or carriage on the track, to make the gate roll to the one side and open when approaching it, and then roll back when the carriage or wagon has passed through to close it. This lever railway is hung upon a pivot, with its long end toward the opening of the gate, so as by its weight at that end to tilt down the gate into its place, self-acting, when the lighter end is relieved from the weight or pressure of a carriage, etc., on the roadway, after it has passed through. The platform, or track which is connected with the lever, may be provided with any suitable fastening, such as a spring switch with a vertical lever at one side, which will set free a catch on the platform, and allow it to act so as to prevent animals opening the gate by merely getting on the platform.

There is claimed for this gate great simplicity of construction; and when its cheapness, utility, and beauty (if desired) shall be remembered, and it is likewise borne in mind what little skill is required to make it, and how little its liability to get out of repair, it is believed that it will be regarded as preferable to the common gate swinging on hinges; and may possibly be esteemed superior to any form of gate among the various inventions of more modern date.

THE GREAT INDUSTRIAL EXHIBITION AT PARIS.

One of the most memorable events in the scientific history of the past year has been the Great Industrial Exhibition of Paris. In many respects it was far in advance of the London Exhibition of 1851. "Every one," says the London Practical Mechanics' Journal, "who compares the two Exhibitions must perceive a decided advance since 1851 in almost every branch of manufacture; and we think that the Paris Exhibition must be held to afford a more complete and accurate idea of the state of the industrial arts of the present day, than did our Exhibition of the state of the arts of that day." There were several distinct parts of the Exhibition having separate buildings near each other. First, the exhibition of the fine arts, containing a wonderful collection of more than 2,000 paintings, the works of painters now living or lately dead, as well as a great number of pieces of sculpture, engravings, etc., amounting in all to 5,112 works of art. Secondly, the "Palace of Industry," and

adjacent to this a circular building called the "Panorama," holding tapestry, Sèvres porcelain, the regalia of France, etc. Lastly, there was a supplemental building, called the *Annexe*, which contained the machinery, raw products, etc. The space devoted to exhibition amounted to about 1,050,000 square feet, this being about 4,000 feet more than the contents of the London Exhibition. The Palace contained 500,000 square feet, the Annexe 400,000, and the Panorama and galleries 150,000. The Palace is in shape an oblong quadrangle, 930 feet by 360, with projecting portions at the corners, and in the middle of the two principal fronts. It is constructed of stone, and is roofed archwise with glass. The doors are twenty-eight in number. The Annexe is nearly three quarters of a mile in length. Excluding the fine arts, the number of exhibitors was about 19,000, or 2,000 more than in London."

The exhibition made by American exhibitors was quite small, and confined mostly to agricultural implements, India-rubber goods, and a few machines. In results, however, the American department was most successful. In the trials of agricultural implements the American machines, whenever competing, bore away the prizes, and, as in England in 1851, established a superiority above all others. In the general agricultural department of the Exhibition little of interest to American exhibitors was shown. The plows, with the exception of the English, could not compare with the American varieties, either in design or workmanship. "The chief anxiety of the contrivers would seem to be," says Mr. Greeley, in the *Tribune* correspondence, "that each shall be thoroughly guarded, at whatever cost, against running too deep into the ground, though to that excess they manifest not the slightest inclination."

"Many of the harrows exhibited were constructed with a respect for the truth that the pointed, wedge-shaped tooth is radically vicious, tending to compact the soil which it tries to pulverize and loosen. Harrow-teeth based on the principle of the plow and the cultivator, cutting easily, lifting and turning over all the soil that they disturb, are evidently coming into fashion."

A drain-tile of somewhat novel construction was exhibited. The novelty consists in an independent *collar* or broad ring (say three inches wide) which loosely covers each junction of the tile, not so much to prevent their filling up with earth as to keep one from sinking below or rising above the other, so as to stop the flow of water. The material is, of course, that of the tile.

"It is unsafe," says the writer above quoted, in commenting upon the agricultural department of this Exhibition, "to condemn what you do not fully comprehend; but many of the European contrivances for mowing, reaping, etc., by horse-power, seem absolutely puerile compared with those known in our country. So the machines for thrashing and cleaning grain here exhibited seem generally such as we have for the last twenty or thirty years been superseding by better, and some of them clumsily made and in bad condition, as if they had been brought here from an old lumber-room, without cleaning."

But a decision made in favor of one of the ten American pianos exhibited, created more astonishment and surprise than the performance of the agricultural machines. "The French people, with their limited knowledge of the 'half-civilized people of America,' pretend to comprehend how it is possible for them to excel in the invention of such labor-saving machines as a sparse

population and a scarcity of hands compel them to invent; but that America should send a piano which could take a premium over the three hundred fine French pianos in the Exhibition is a problem which they can not understand. They imagined that they furnished the United States with nearly all the pianos they required, and that in consequence it was an industry not yet developed there, and that the people were not capable of excellence in that branch."

The following are the principal awards made at the Paris Exhibition to American exhibitors:—

Grand Medals of Honor, Gold.—McCormick's Reaper and Mower; Chas. Goodyear's Preparations of Vulcanized India-rubber.

Medals of Honor, Gold.—J. A. Pitts, of Buffalo, Thrashing Machine; Messrs. Bache & Saxton, Washington, D. C., United States Standard Weights and Measures; Lieut. M. F. Maury, National Observatory, Washington, Wind and Current Charts.

Medals of the First Class, Silver.—Col. Allston, S. C., Raw Cotton; John H. Manny, Illinois, Reaper and Mower; Tounsley & Read, N. J., Oscillating Steam-Engines: Thos. Blanchard, Boston, Machine for Bending Ship-Timber; T. Richmond, Boston, Machine for Cutting Boiler Iron; Singer & Co., New York City, Sewing Machines; D. King, Albany, Model of Steamboat; U. S. Navy Department, Models of Vessels of War; Sam. Colt, Conn., Fire-arms; Merriam, Brewer & Co., Boston, Cotton Fabrics; Gov. Seabrook, S. C., Raw Cotton; A. W. Ladd & Co., Boston, Pianos; Claude Mirmont, N. Y., Violins.

Medals of the Second Class, Mixed Commission, Silver.—Hamilton Mills, Lowell, Cotton Fabrics; Manchester, N. H., Print Works, Printed Fabrics.

No part of the Great Exhibition of Paris appears to have excited a greater interest on the ground of novelty, than the contributions from Algeria. This territory occupies a length in Northern Africa of 700 miles from east to west, and of indefinite breadth from north to south, gradually merging into the domain of the mountain tribes, for its southern limits are traversed by ranges of the Atlas mountains. The whole is divided into three provinces—Algiers, Oran and Constantine. A great portion of this country is distinguished by its natural fertility; yet the indolence of the people, the oppression of the government, the want of roads and interior communications, caused three fourths of it to be left uncultivated, till, in 1830, it was entirely subjugated by the French; and now Europe is astonished at the extent of the products indicative of the vast resources of the country, as exhibited on the present occasion. The specimens of wood sent from this district were extremely interesting and instructive; of the olive-tree, planks and blocks of enormous size were exhibited; one of the latter, the base of the trunk, with the bark on, would be considered very large for an oak. The color and graining of the wood, and of the root-portion especially, are eminently beautiful, and render it invaluable for ornamental and cabinet-work. Under the name of *Thuja*, were shown some samples of a most beautiful wood. This Thuja is common throughout Algeria, most so when proceeding from east to west. Though but recently restored to notice, it was highly prized by the ancients. According to Pliny, the "Citrus" (such was its name among the Romans) was so rare that tables made of it were

hardly to be procured even at fabulous prices; and the females who were reproached with extravagance in dress and ornaments, retorted on their husbands with the prices which their lords had paid for tables of citrus-wood. Cicero gave the sum of a million of sesterces, equal to 250,000 francs, or £10,000, for one of them, and still larger prices are cited by Pliny, especially for one table which had belonged to the Moorish king, Juba. The root, with its knots, afforded the most prized portions; and though it was generally used for inlaying and veneering, the Emperor Commodus possessed also vases and cups made of it.

The peculiar qualities of this wood explain its value and fashion. None is so full of spots, satiny luster, and variegated veins; it takes a lovely and perfect polish, and the hues pass from deep fiery red to those of the pinkest mahogany; and these tints are permanent, not fading like rosewood, or becoming black like mahogany. It combines so many elegant qualities, that the Parisian cabinet-makers unanimously prefer the Thuja wood to every other.

The London *Athenæum*, in commenting on the Great Industrial Exhibition of Paris, makes the following suggestive remarks in reference to the great artistic effect so carefully studied in every production by the French people.

"It would appear to many people that Art in France has been here cultivated, not in aid of, but at the expense of, all the solid qualities of manufacturing industry. In their haste to print the pattern they have neglected the modest office of the loom. In their admiration of a brilliant dye they have forgotten the uses of a solid thread. We are told their furniture is splendid with golden trellice-work, marvelous for the rich grouping of costly materials; but as yet no Paris door swings fairly upon its hinges. In cotton cloth they can not approach the inartistic genius of Manchester. English steel defies the competition of the first Gallic manufacturers. We are reminded that we might even carry the distinction from the *salon* where glows the furniture of Jeauselme to the kitchen wherein the disciples of Brillat de Savarin preside. Light as air—daring to rashness—gorgeous, till the eye aches and is fatigued—is the style of Art at which France has arrived in her workshops. The draughtsman here knows no bounds. All that floats to the surface of his brain goes direct, without a second thought, to the tip of his pencil. He wants a handle to the jug upon which he is engaged:—two crocodiles, one with its hind-quarters in the ample jaws of the other, are not too formidable for his purpose. A tailor gives him an order:—the Obelisk of Luxor becomes a stripe down the leg of a pair of trowsers. Hieroglyphics tell upon flounces. Coins that would enrich any museum, are effectively strung together for a lady's hair. A stack of arms, with Napoleon in a contemplative attitude before them, are an apt combination for a tooth-pick stand. A chiffonier, with his basket at his back and his lantern in his hand, stands in bronze, with a load of lucifers behind and a spirit-burner in his lantern, at the convenience of the smoker. The marriage of the Emperor is not a composition too complex for the embroiderer of shirt-fronts, as the reader may notice in the French Gallery of the Universal Exhibition. Neither is the French designer inconvenienced by 'Puritanic stays;' as his designs, realized in sugar

and chocolate, and displayed in gorgeous shops on the Boulevards and in the Rue Vivienne every New Year's Day, fully testify.

"But the artist-workman of Paris does not produce in common materials. It is not his mission to diffuse a sense of beauty over his country. If he can conceive any errand beyond that which enables him to frequent his Barrière ball, it is to show how ornament may be added to ornament—how silver may be wedded to gold, and ebony to satin-wood. In the Fable for Critics, we are assured that

> Over-ornament ruins both poem and prose—
> Just conceive of a Muse with a ring in her nose!

Now the art-workman's Muse *has* a ring in her nose. Not a plain gold ring, if you please; but a circle studded all round with gems! His Muse wears nothing plain. Her bonnets are orchards; her dresses employ hundreds of hands to each; her fingers display the revenue of a State; and upon her bosom lies the wealth that would feed armies. To this Muse the Paris workman turns his eyes unceasingly, looking out from a *mansarde* where a pot of flowers, bought near the Madeleine after market-hours, is the only beauty. For it is remarkable that Paris, the city where Art is the passion of the masses, is conspicuous for the tastelessness of its common household goods. Angular straw chairs, deal tables, thick clumsy crockery, and frightfully barbarous stone-ware, make up the poor man's *ménage*. With the middle classes, you see a gaudy *salon*, with a splendid clock, chairs elaborately ornamented, handsome lace curtains—but here household grace ends. A tea-service is permanently placed upon the *salon* table for the inspection of visitors, and very beautiful this service is, often. But proceed to the dining-room, examine the crockery in daily use, and you will be thoroughly disenchanted; for these will invariably be found coarse and ugly. It is not that the master of such a *ménage* has no appreciation of Art-manufacture: the truth is, he loves it; but it is beyond his means. All he can afford is a *salon* furnished, as he expresses it, with *luxe;* and there being no medium between *luxe* and positive plainness and ugliness, he is compelled to adopt the style, or want of style, perceptible in his dining-room."

NATURAL PHILOSOPHY.

ON THE CONSTRUCTION OF THE TERMINATIONS OF LIGHTNING-CONDUCTORS.

At a recent meeting of the Scottish Society of Arts, an animated discussion took place in reference to the construction of the terminations of lightning-conductors—one party maintaining that the present pointed terminations were theoretically and practically wrong, and that balls, or knobs, should be substituted, and the other that the electricity was best discharged by pointed conductors. The arguments in favor of the use of balls instead of points were given by Mr. Hepburn, who stated "that he had been led to doubt the efficiency of the conductors usually adopted, terminating in points, which was contrary to the plan found to be necessary in the management of artificial electricity, in which, while the fluid is gradually collected from the excited cylinder by a row of pointed wires attached to the prime conductor, its transmission from the conductor to the battery, and the discharge of the battery itself, is always effected by balls. It thus appears that for the absorption and transmission of an accumulated mass of electricity an extended surface is required; and as in the protection of buildings it is necessary to provide for the instantaneous absorption of a concentrated mass of electricity darting through the air in the form of a flash or ball, Mr. Hepburn conceived that the conductor ought to terminate in one or more pear-shaped balls, having a surface sufficient to absorb at least as much of the fluid as the descending rod is capable of carrying to the earth. It remains to be determined whether a large hollow ball, or a smaller solid one is preferable."

STRINGFELLOW S POCKET ELECTRIC BATTERY.

This is an ingenions arrangement for supplying a continuous stream of electric fluid for medical purposes, and it especially recommends itself by its extreme portability, and by the convenient manner in which it can be applied. A battery of sufficient power for most purposes is contained in a holder no larger than a lady's card-case, and it owes its comparative compactness to contrivances by which an immense number of minute surfaces of suitable metals are arranged so as to induce the voltaic action. The novelty of the arrangement consists in the repetition of a peculiarly constructed element, which is made as follows: A narrow strip of thin zinc is bound round with a

flat copper wire, some non-conducting substance, as cotton, silk, or gutta-percha, being interposed between the two metals. At each end of the elements short lengths of flat copper wire are made to project, and these are soldered to the ends of the zinc plate of the adjacent element. Any metals capable of inducing voltaic action may be used, and the inside strip may be covered by the outer metal in a variety of ways. In one of the forms adopted, rows of transverse slots are cut out of the enveloping metal. In another are holes, like perforated window-blinds; while in a third the outside metal is in the form of wire-gauze, which last is said by the inventor to act very well. The elements are soldered together in sets of ten or eleven each, and two or more of these sets are hinged together to form a battery. At each end of the battery is fixed a small socket—one being the positive pole, and made of gold; the other the negative, and made of silver. These sockets project through holes provided for them in the case, and it is to them that the conductor cords are attached by a common clasp. These cords have a fine metal wire twisted up with them, and covered by an external braiding of silk or mohair. They terminate in small metal plates, which are provided with slots at the back for the introduction of a tape to bind them to the body. The battery is excited by being slightly moistened by dilute acetic acid, and the conductor-plates are wetted and applied at the parts between which it is wished to pass an electric current. The battery, in its neat case, may be carried in the pocket, or worn about the person in any convenient manner.

APPARATUS FOR DISCHARGING ATMOSPHERIC ELECTRICITY FROM TELEGRAPH WIRES.

An invention, recently patented in the United States by John N. Gamewell, of England, relates to an apparatus for discharging into the earth all atmospheric electricity with which the telegraph wires become surcharged when the atmosphere is in a highly electrical state, thereby obviating all danger of injury to the magnet or telegraph instrument, and enabling the telegraph to be operated during the severest thunder storm. The theory on which this instrument is constructed is based upon the established principle that atmospheric electricity will leap from one conductor to another, but that a galvanic current will not pass through the smallest space without a continuous conductor.

Mr. Gamewell provides an angular coil of wire, placed near the telegraph instrument or receiving magnet. The wire composing the coil is either made tapering, and diminishes from the size of the telegraph wire to a very small diameter, or in lieu thereof, the elbows of the coil are made of a poorer conducting metal than the other portions. This is for the purpose of causing the atmospheric electricity, when it arrives at the elbows, to leap from them on to some conducting points of better metal, which are placed almost in contact with the elbows. The conducting points are all arranged on a metallic bar, and this is connected with the earth by a rod. The apparatus is placed between the end of the telegraph wire and the telegraph instrument, so that all electrical currents, in approaching the instrument, must pass through the el-

bowed coil. The conducting points attract off the atmospheric electricity, and convey it safely to the earth, while the galvanic current passes freely to the instrument.

M. Becquerel, of France, has also recently presented to the French Academy an apparatus, invented by M. Bianchi, which is intended to preserve telegraphic apparatus from the disturbing influence of atmospheric electricity. It consists of a metallic sphere, traversed by the circuit wire, and kept in the center of another glass sphere, formed of two hemispheres united by a broad copper ring, armed at its inside with equi-distant points directed toward the center of the metallic sphere, and approaching within a short distance of its surface. The two hemispheres end in sockets, into which the connecting wire passes and is cemented. The lower part of the copper ring is provided with a metallic stop-cock, which permits a vacuum to be made in the apparatus, and kept in it if it be thought necessary. This stop-cock has a screw-thread which is to receive a metallic rod designed to put the metallic armature into direct connection with the earth, while the circuit wire, and the sphère which forms part of it, are completely insulated. All the atmospheric electricity which comes upon the conducting wire of the telegraph is transmitted to the ground through the points with which the ring is armed.

Such an apparatus is to be erected at each station; experiment has proved to the author that when the discharge of a battery of eight jars is passed into a telegraphic conductor provided with this apparatus, the dynamic current is not affected, and all the statical electricity passes into the earth, under the influence of the points.—*Comptes Rendus.*

ON THE "STRATIFICATION" OF ELECTRIC LIGHT.

Before the Paris Academy a paper has been read by M. Gaugain on the stratification of electric light, as he calls that disengagement of differently colored light we see produced when an electric spark is transmitted through gas, rarified by the air-pump. Of all the phenomena produced by the passage of electricity through rarefied mediums, perhaps the most singular is visible in the residuary vapors of alcohol, or the essence of turpentine, where the luminous nebulosity, caused by the passage of electricity, is divided perpendicularly to the direction of the current, in parallel sections, separated by dark spaces. These alternatives of light and obscurity were thought to point out the existence of an undulatory phenomenon, and some philosophers hoped it would enable them to detect the still hidden mechanism of the propagation of electrical actions. This hope M. Gaugain dissipates. He especially examined three different mediums—air, exempt from vapors; the vapor of essence of turpentine; and mixtures of variable proportions of air and the vapor of essence of turpentine. It is generally admitted that the phenomena of stratification may be produced in air exempt from vapor; for, when the observer uses a globe in which turpentine, alcohol, or any other substances suitable for the formation of strata have been used, the strata are constantly obtained, even after the air in the globe has been several times renewed. Nevertheless, M. Gaugain affirms these strata are not due to the

air itself, but to the remaining traces of the combustible vapor, which disappear if some drops of concentrated sulphuric acid are placed inside the globe. Then the electrical light presents these characteristics: the negative ball and the rod which supports it are enveloped by a luminous aureola, which seem to be formed of several layers, which are all of a blue color, but of different shades; the positive ball, and a certain portion of its supporting-rod, are also enveloped by a luminous, brilliant, rosy, very thin and cotton-like layer; and between the two balls is a sort of cloud of continued, diffused, red-colored light, in the form of a candle's flame. When the electric light is produced in a space exclusively occupied by essential vapors, the negative aureola presents the same characteristics as when in air, but the different layers which form it are of a dimmer color. There is no luminous layer upon the positive ball, and between the two balls there is a sheaf of light, wide-spread, white, and finely stratified. When the medium is a mixture of air and the vapor of essence of turpentine, the aspects of the light vary with the proportions of the mixture; when the air is in great excess, the appearance is nearly the same as in pure air, but the luminous sheaf is divided into six or seven irregular forms of a lively red, which are sometimes nearly a centimeter thick; they have a very short existence. In a few seconds they are succeeded by that cloudy and diffuse light which characterizes the air exempt from vapors; and, commonly, if the current is interrupted some minutes, the red strata momentarily re-appear; when the essence of turpentine is in great excess, the luminous appearances are the same as in the case when the essence is alone; the strata, however, are red and purplish. When the current has acted for some time, the red color gradually disappears, and is replaced by that dim color, proper to the vapor of essence; a temporary interruption of the current does not make the red color re-appear. These two last phenomena are easily explained, if it be granted, as M. Gaugain contends, the red strata arise from the combustion of the essence; when the combustion is ended, the red strata are replaced by the diffused light which characterizes air exempt from vapor, or by the white strata which mark the vapor of essences. This assumption, M. Gaugain clearly shows by experiment to be founded on the truth. But why is not the effect uniform?—why, by the side of a brilliant, is there an obscure section? M. Gaugain says, because the first effect of electrical forces is to separate materially the gaseous medium into sections of different natures.

CAUSES OF CHAIN LIGHTNING.

In a paper recently communicated to the Royal Society, Mr. Grove stated, and proved by experiment, that the effects of rarefaction upon gases, either produced by the air-pump or by heat, tend to render discharges of electricity more facile, and to enable them to pass across much larger spaces than would otherwise be the case. So strikingly was this evidenced with flame, that when the flame of a spirit-lamp was held near one of the terminal points of a coil-apparatus, the terminals being separated to a distance far beyond that at which the spark would pass in cold air, the spark darted to and along the

margin of the flame, and could be curved or twisted about in any direction, at the will of the experimenter, giving a perfect illustration of the crooked form of lightning, and of the probable reason why it does not pass in straight lines—the temperature of the air being different at different points in its passage, and much of this variation of temperature being in all probability occasioned by the mechanical effects of the discharge itself upon the air.

VELOCITY OF THE ELECTRIC CURRENT.

M. Quetelet, at a recent meeting of the Belgian Academy, described Mr. Airey's experiments with the electric telegraph to determine the difference of longitude between Greenwich and Brussels. The time spent by the electric current in passing from the one observatory to the other was found to be 0.109″ or rather less than the *ninth part of a second*, and this determination rests on 2,616 observations. The distance between the towns being 270 miles, the velocity of the current, supposing it to be uniform, must rather exceed 2,500 miles per second, or about one seventh greater than that obtained by the American observers, a speed which would "girdle the globe" in ten seconds. The difference of longitude from two series of observations, and by two methods, was found to be 17′28.9″ Observations made by an eclipse of the sun in May 1836, gave precisely the same results, which may be considered the most correct. An eclipse of the sun in 1842 gave four tenths of a second less; lunar occultations gave nine tenths of a second less; and observations by chronometers gave one second and three tenths less. A second in this case represents a distance of 455 yards, and a tenth of a second 45½ yards. Assuming the first-mentioned time to be correct, the error in the chronometrical determination is equivalent to 591 yards, or the ninth part of a mile, which, after all, is only the 2430th part of the whole distance.

THERMO-ELECTRIC CURRENTS.

A number of interesting experiments on the construction of thermo-electric batteries have recently been conducted by Mr. Adie, of England, the object, to a certain extent, being to test the direction of the electric current in relation to that in which the heat passes. In the first instance a bismuth joint was formed by soldering together two bars of the same metal—72 pairs of plates being thus connected. When gold, silver, platinum, copper, zinc, cadmium, antimony, iron, or soft steel, were employed, the electric current flowed in an opposite direction to that of the heat. When palladium, lead, and tin were used, the direction of both currents was the same. When two bars, each of a different metal, soldered together by bismuth, were acted on, the results were various. In 28 pairs the direction of the heat current was opposed to the electric; in one pair composed of lead and tin, the heat and electricity crossed the joint in the same direction; in 31 cases the pairs acted according to their thermo-electric relations, independent of the side joint to which the heat was applied. There were only four cases in which the heat and electricity coursed in the same direction, and in these the peculiarity was attributed to the tend-

ency the bismuth had to alloy with the other metals; but on repeating the experiments by tying, instead of soldering the bismuth between the plates, in every case the heat and electric currents traveled in opposite directions. The pieces of bismuth in these experiments were obtained by holding a bar of metal in the flame of a candle until tear-like drops fell, which were received on a smooth surface as discs, to obtain the requisite thickness; and afterward cut into small pieces from 1-40th to 1-50th of a grain. The result arrived at was that the source of the thermo-electric current was at the surface of the joint; and that to make a thermo-electric battery for practical purposes a contact joint is generally better than a joint by soldering, in which the metals have a tendency to become alloyed, and that in some cases the amount of the electric current is greatly dependent upon the surface of the metals in contact. It is probable that, although experiments on thermo-electricity have yet been productive of no definitively practical results, telegraphic communication may yet be established by the simple agency of a flame of gas.

ELECTRIC TELEGRAPH IN INDIA.

We extract the following notice of the peculiarities of the electric telegraph in India, from a report recently made to the Court of Directors of the East India Company, by Dr. W. B. O'Shaughnessy. He says:—

"The overground lines differ materially from those used in America and England. No wire is used, but a thick iron rod $\frac{3}{8}$ths of an inch in diameter, weighing one ton to the mile. The advantages of using thick iron rods are stated to be the following:—immunity from damage or fracture by wind or mechanical voiolence; immunity from injury if accidentally thrown down; they can not be broken or bent without great trouble; their mass of metal gives so free a passage to the electric current no insulation is required, the rods are attached to the bamboo posts, etc., without employing glass, porcelain, or any other non-conductor, yet through these lines they work without interruption, during tropical deluges of rain, with miniature batteries consisting of 12 cells of platinum wires and zinc; no tension is required, as is the case with wire lines; the thick rods admit of rusting that would be fatal to a wire line not coated with zinc; rods (in India) are not more costly than wires. In India it is necessary to use the simplest instruments possible, as they are apt to be deranged, owing to the prodigious electric excitement of the atmosphere, and there are no mechanics at hand in the rural districts. In all the lines running north and south there is a natural current of electricity continually flowing, and this current deranges the polarity of the needles, confers permanent polarity on soft iron, and produces chemical stains on prepared tissues."

FARMER'S IMPROVEMENT IN THE TELEGRAPH.

At the Providence meeting of the American Association, Mr. Moses G. Farmer, of Boston, gave an account of some improvements recently effected by him in the electric telegraph, whereby two or more terminal stations can make simultaneous use of the same wire for the transmission of messages. By

a very simple combination and arrangement of the two systems of House and Morse, from two to twenty-eight messages might be in the process of transmission over the same wire at one and the same time. Thus: Suppose we have two letter-printing telegraphs, one situated in Boston, the other in New York, and connected as usual for the purpose of transmitting messages; suppose, further, that the axis of the type-wheel in the Boston machine was connected by a wire with one pole of a suitable galvanic battery, while the other pole of this battery was connected by an extended wire with the axis of the type-wheel of the machine in New York; further, let us remove the two type-wheels from their axis and substitute therefore a slender spring on each, at right angles to the axes, and which in the course of a revolution of the shafts shall make contact with the twenty-eight circular segments arranged concentrically around the axis of the type-wheel and insulated from it and from one another; still further, let each of the twenty-eight segments in the Boston instrument be connected severally with one pole of a complete "Morse" machine, which is, at the other pole, in connection with the earth; there will then be twenty-eight "Morse" machines at Boston attached to the "House" machine, and by the revolution of the type-wheel axis these twenty-eight machines will be successively put into connection with the common communicating wire. Suppose twenty-eight "Morse" machines similarly connected with the "House" machine at New York; if now the slender spring in each "House" machine presses on the "A" segment and the two type-wheel shafts be made to rotate rapidly in the usual manner, at every revolution of the type-wheels the "A" machines at Boston and New York will be at once in connection with each other by means of the slender springs, the segments, and the common wire. If the type-wheels should make twenty revolutions per second, the dots or impulses would succeed each other so rapidly as to make nearly a continuous line, which could be broken up into short and long lines by means of the key in the usual manner. He had operated with this arrangement on a circuit of several miles in length at Boston.

IMPROVEMENT IN ELECTROTYPING.

When a page of type, or a wood engraving, is to be duplicated by the electrotype process, an impression of the article to be reproduced, is taken in soft beeswax. The mold thus made is dusted over with finely ground plumbago, and then placed in a solution of sulphate of copper, where it is subjected to the galvanic battery. The plumbago serves as a metallic base, on which copper is deposited in the same manner that substances composed wholly of metal are coated or galvanized. The dusting of the wax molds has heretofore been done by hand, which is a slow and laborious operation; it is also imperfect, for unless great care is taken to dust every portion evenly, the electrotype will prove defective. An improvement has been recently patented by Mr. J. A. Adams, of Brooklyn, N. Y., for accomplishing this dusting wholly by the aid of a vibrating brush, combined with a carriage-way, thus performing the work more perfectly and economically than before.

TELEGRAPHIC COMMUTATOR.

M. Garnier, at the Great Exhibition of Paris, exhibited a telegraph "commutator" of very ingenious construction, intended to be used with Morse's telegraph. Instead of operating the key by hand for sending messages in the common way, the message was composed beforehand, and disposed helically along a cylinder, which is provided with two thousand keys, made of some non-conducting substance, and according as they are arranged on the cylinder they effect the breaking and closing of the circuit and write the message. The operator turns a small winch, and his message is written a thousand miles distant in dots, dashes, and spaces, with the greatest rapidity. We witnessed a dispatch of two hundred and ten words transmitted by this apparatus in one minute. The mere idea thus ingeniously carried out by M. Garnier, as applied to the Morse telegraph, is undoubtedly new; but it was substantially applied to Bain's telegraph in 1847. Bain composed his messages on strips of perforated dry paper, which opened and closed the circuit. These strips were run between rollers by simply turning a small winch, and thus the message was sent forward through the wires at a great rate.—*Scientific American.*

EXPERIMENTAL OBSERVATIONS ON AN ELECTRIC CABLE.

In the Physical Section of the British Association, Glasgow meeting, Mr. W. Whitehouse introduced the subject of submarine telegraphing. He regarded it as an established fact that the nautical and engineering difficulties which at first existed had been already overcome, and that the experience gained in submerging the shorter lengths had enabled the projectors to provide for all contingencies affecting the greater. Mr. Whitehouse then drew the attention of the section to a series of experimental observations which he had recently made upon the Mediterranean and Newfoundland cables, before they sailed for their respective destinations. These cables contained an aggregate of 1,125 miles of insulated electric wire—and the experiments were conducted chiefly with reference to the problem of thé practicability of establishing electric communications with India, Australia, and America. The results of all the experiments were recorded by a steel style upon electro-chemical paper by the action of the current itself, while the paper was at the same time divided into seconds and fractional parts of a second by the use of a pendulum. This mode of operating admits of great delicacy in the determination of the results, as the seconds can afterward be divided into hundredths by the use of a "vernier," and the result read off with the same facility as a barometric observation. Enlarged fac-similes of the electric autographs, as the author calls them, were exhibited as diagrams, and the actual slips of electro-chemical paper were laid upon the table. The well-known effects of induction upon the current were accurately displayed; and contrasted with these were other autographs showing the effect of forcibly discharging the wire by giving it an adequate charge of the opposite electricity in the mode proposed by the author. No less than 8 currents—4 positive and 4 negative—were in this way transmitted in a single second of time

through the same length of wire (1,125 miles), through which a single current required a second and a half to discharge itself *spontaneously* upon the paper. Having stated the precautions adopted to guard against error in the observations, the details of the experiments were then concisely given, including those for "velocity," which showed a much higher rate attainable by the magneto-electric than by the voltaic current. The author then recapitulated the facts, to which he especially invited attention: First, the mode of testing velocity by the use of a voltaic current divided into two parts (a split current), one of which shall pass through a graduated resistance-tube of distilled water, and a few feet only of wire, while the other part shall be sent through the long circuit, both being made to record themselves by adjacent styles upon the same slip of electro-chemical paper. Second, the use of magneto-electric "twin-currents," synchronous in their origin, but wholly distinct in their metallic circuits, for the same purpose, whether they be made to record themselves direct upon the paper, or to actuate relays or receiving instruments which shall give contacts for a local printing battery. Third, the effect of induction, retardation of the current, and charging of the wire, as shown autographically; and contrasted with this—fourth, the rapid and forcible discharging of the wire by the use of an opposite current; and hence—fifth, the use of this as a means of maintaining or restoring at pleasure the electric equilibrium of the wire. Sixth, absolute neutralization of currents by too rapid reversal. Seventh, comparison of working speed attainable in a given length of wire by the use of repetitions of similar voltaic currents as contrasted with alternating magneto-electric currents, and which, at the lowest estimate, seemed to be 7 or 8 to one in favor of the latter. Eighth, proof of the co-existence of several waves of electric force of opposite character in a wire of given length, of which each respectively will arrive at its destination without interference. Ninth, the velocity, or rather amount of retardation, greatly influenced by the energy of the current employed, other conditions remaining the same. Tenth, no adequate advantages obtained in a 300 mile length by doubling or trebling the mass of conducting metals. The author, in conclusion stated his conviction that it appeared from these experiments, as well as from trials which he had made with an instrument of the simplest form, actuated by magneto-electric currents, that the working speed attainable in a submarine wire of 1,125 miles was ample for commercial success. And may we not, he added, fairly conclude also that India, Australia, and America, are accessible by telegraph without the use of wires larger than those commonly employed in submarine cables?

ON PERISTALTIC INDUCTION OF ELECTRIC CURRENTS IN SUBMARINE TELEGRAPH-WIRES.

The following paper was read to the British Association by Professor Thomson. "Recent examinations of the propagation of electricity through wires in subaqueous and subterranean telegraphic cables have led to the observation of phenomena of induced electric currents, which are essentially different from the phenomena (discovered by Faraday many years ago) of what has

hitherto been called electro-dynamic, or electro-magnetic induction, but which, for the future, it will be convenient to designate exclusively by the term electro-magnetic. The new phenomena present a very perfect analogy with the mutual influences of a number of elastic tubes bound together laterally throughout their lengths, and surrounded and filled with a liquid which is forced through one or more of them, while the others are left with their ends open or closed. The hydrostatic pressure applied to force the liquid through any of the tubes will cause them to swell and to press against the others, which will thus, by peristaltic action, compel the liquid contained in them to move in different parts of them in one direction or the other. A long solid cylinder of India-rubber, bored symmetrically in four, six, or more circular passages parallel to its length, will correspond to an ordinary telegraphic cable containing the same number of copper-wires, separated from one another only by gutta percha; and the hydraulic motion will follow rigorously the same laws as the electrical conduction, and will be expressed by identical language in mathematics, provided the lateral dimensions of the bores are so small, in comparison with their lengths, or the velocity of the fluid so great, that the motions are not sensibly affected by inertia, and are consequently dependent altogether on hydrostatic pressure and fluid friction. Hence the author considers himself justified in calling the kind of electric action now alluded to, *peristaltic induction*, to distinguish it from the electro-magnetic kind of electro-dynamic induction. Among the results noticed, he mentioned, as being of practical importance, that the experiments which have been made on the transmission of currents backward and forward by the different wires of a multiple cable, do not indicate correctly the degree of retardation that is to be expected when signals are to be transmitted through the same amount of wire laid out in a cable of the full length. It follows that expectations as to the working of a submarine telegraph between Britain and America, founded on such experiments, may prove fallacious; and to avoid the chance of prodigious losses in such an undertaking, the author suggested that the working of the Varna and Balaklava wire should be examined. He remarked that a part of the theory communicated by himself to the Royal Society last May, and published in the Proceedings, shows that a wire of 6 times the length of the Varna and Balaklava wire, if of the same lateral dimensions, would give 36 times the retardation, and 36 times the slowness of action. If the distinctness of utterance and rapidity of action, practicable with the Varna and Balaklava wire, are only such as to be not inconvenient, it would be necessary to have a wire of 6 times the diameter; or better, 36 wires of the same dimensions; or a larger number of still smaller wires twisted together under a gutta percha covering, to give tolerably convenient action by a submarine cable of 6 times the length. The theory shows how, from careful observations on such a wire as that between Varna and Balaklava, an exact estimate of the lateral dimensions required for greater distances, or sufficient for smaller distances, may be made. Immense economy may be practiced in attending to these indications of theory in all submarine cables constructed in future for short distances; and the non-failure of great undertakings can alone be insured by using them in a preliminary estimate."

On the Polar Decomposition of Water by Frictional and Atmospheric Electricity, by Professor Andrews.—The author having drawn attention to the fact that water had never been decomposed by the action of the common friction electricity, so as to collect the gases and exhibit them at the opposite poles, stated that the cause of the failure of the experiment was the solution of the gases in the mass of the liquid. By fusing platina wires in thermometer tubes this difficulty is avoided, and the gases may be then obtained and collected with the same facility as in ordinary eudiometric experiments. By arranging a series of such tubes, the operations may be almost indefinitely repeated. On raising an electrical kite, the author succeeded in obtaining the polar decomposition of water by atmospheric electricity. The observations were made in fine weather, when the atmosphere was not usually charged with electricity. Although the gases were easily collected and measured, from the delicate form of apparatus employed, the quantity of water decomposed in this case amounted only to one 700,000th of a grain in the hour.—*Proc. British Association.*

Bonelli Experiments in Electric Communication.—Experiments have recently been made in Sardinia by M. Bonelli with a view of using the common iron railway track as a conductor of electricity for telegraphic purposes. It is thus proposed to convert railways into telegraphic lines and make the electro-magnetic machine an attachment and servant to the locomotive. In an experiment reported, it is stated that a locomotive running at full speed repeatedly exchanged messages with the station whence it started. The questions and answers were varied and repeated during numerous trips, without a single fault, and the inventor finally announced his complete success to the Minister of Public Works at Turin from a car running at the rate of a mile in two minutes.

THE MEDITERRANEAN SUBMARINE TELEGRAPH.

The work of completing the Mediterranean Electric Telegraph, which will ultimately furnish a communication between London, Egypt, and India, has been vigorously pushed during the past year. It will be remembered that last year* 110 miles of cable were laid down between Spezzia and the most northern point of Corsica. For this section of the line 90 miles of cable, weighing eight tons to the mile, and containing six insulated wires, were required; the remainder was taken to the straits between Corsica and Sardinia, and twelve miles were laid down there, the communication having meantime been completed along the island of Corsica by land. The communication being now complete from London to Cagliari, in the south of Sardinia, and the line from Algiers to Cape Bonan, on the African coast, having been opened January, 1855, nothing is now wanted to complete the communication between London and Algiers but a submarine cable from Cape Spartivento, adjoining Cagliari, to Bonan. This cable is already manufactured, and is the largest and heaviest, beside being the longest, ever laid down. It is 150 miles long, each mile weighing 8 tons, and the whole cable weighing 1,200 tons. This is exclusive of 12 miles of lighter cable sent with it to avoid all chance of

* See Annual of Scientific Discovery for 1855, pp. 166–168.

deficiency. In its stowage in the vessel for transportation, the greatest care has been exercised owing to the enormous weight, and the circumstance that it is all in one piece. Seventy-one miles of it have been put in the lower hold, forty-two miles on the orlop deck, thirty miles in 'tween decks, seven miles in the after hold, and the twelve spare miles of what is called small cable, although it weighs five tons to the mile, is also on 'tween decks, and every one of these portions has to be shored at very short intervals, to prevent the movement of the cable.

In laying down the last portion of the cable, that between Spezzia and Corsica, it took five days, including the stoppage that had to take place in cutting the cable, and going round to lay the short lengths between Corsica and Sardinia. It is expected that the present cable will be laid down in four days. The Mediterranean Telegraph Company anticipate that in two years and a half they will have a direct communication with Bombay, and thence, by telegraphs already at work in the presidencies, to Calcutta; and they consider this line they are just about to complete as only the preliminary step to this result. Their proposed line, joining the one at present open to Cagliari at Cape Spartivento, will first be taken to Malta, and thence direct under the Mediterranean to Alexandria. This will be an immense distance: 984 miles of submarine cable without a station; from Alexandria to Suez, by land, 248 miles; another submarine cable under the Red Sea to Aden, with two stations, Cosiri and Liddah, 1,552 miles, and from Aden to Bombay, with stations at the Kooria Moorta Islands and Ras-al-had, 1,900 miles. When this undertaking is completed the communication with Calcutta, which now takes on average thirty-six days, will be reduced to a few minutes. Professor Faraday, about two years ago, called the attention of telegraph companies to the fact that there was great difficulty in sending any communication through a greater length of wire than 300 miles; but since that time Mr. Brett, the Superintendent, has been experimenting, with a view to overcome this difficulty, and has perfectly succeeded in doing so. By connecting each individual wire in this coil of six, and also those belonging to another cable intended for an American company, he was enabled to experiment on a length of 1,250 miles with perfect success, and he has prepared a new instrument for use with wires of great length.

ELECTRIC TIDE-GUAGES AND REGISTERS.

Throughout the long extent of the American sea-board there are many harbors, much frequented by coasting and other vessels, where the entrances are blocked by sand-bars or reefs, over which, at certain stages of the tides, there is not a sufficient depth of water to permit safe navigation. The same may be said of various shoals. It is often a matter of difficulty for a mariner, in approaching such places, to determine whether or not the depth is sufficient for his vessel: through a want of correct information he is often delayed from going into port, and is driven off by a storm; or, what is more frequent, his ship strikes bottom, and becomes a wreck. An invention by Alex. Boyd of New York, is intended to guard against these difficulties.

He erects a frame-work on the locality of danger, in which he places a combination of simple mechanism for raising and lowering signals—flags or balls for the daytime, and colored lights for the night. The mechanism is operated by a float resting in the water. As the tide rises and falls the machinery moves and the signals change. Thus, there may be a signal for each foot of depth; when the water is two feet deep, two signals will be shown; as soon as the tide has risen another foot, three signals will be exhibited—and so on, *vice versâ.—Scientific American.*

On the detection and measurement of Atmospheric Electricity by the Photobarograph and Thermograph.—Photography has already rendered considerable aid to science, and some results brought before the British Association by Mr. Johnson, Radcliffe Observer, Oxford, furnish an example of this. On examining and comparing the registrations of the thermometer and barometer certain peculiarities presented themselves which indicate a curious connection between the course of these instruments and the state of the weather. The line which indicates this course is sometimes serrated, sometimes even and continuous; and these appearances correspond to certain determinate states of the weather. The most remarkable result is a sudden change of the height of the barometric column, which takes place simultaneously with the occurrence of a peal of thunder:—a contemporaneous effect was produced upon the thermometer.

ON THE AURORA BOREALIS.

At the last meeting of the British Association, Sir John Ross, presented a communication, in support of a theory respecting the origin of the Aurora Borealis, which he first promulgated some years ago. Sir John Ross says:— "It having occurred to me that, if my theory was true, namely, 'that the phenomena of the aurora borealis were occasioned by the action of the sun, when below the pole, on the surrounding masses of colored ice, by its rays being reflected from the points of incidence to clouds above the pole which were before invisible,' the phenomena might be artificially produced; to accomplish this, I placed a powerful lamp to represent the sun, having a lens, at the focal distance of which I placed a rectified terrestial globe, on which bruised glass, of the various colors we have seen in Baffin's Bay, was placed, to represent the colored icebergs we had seen in that locality, while the space between Greenland and Spitzbergen was left blank, to represent the sea. To represent the clouds above the pole, which were to receive the refracted rays, I applied a hot iron to a sponge; and, by giving the globe a regular diurnal motion, I produced the phenomena vulgarly called "The Merry Dancers," and every other appearance, exactly as seen in the natural sky, while it disappeared as the globe turned, as being the part representing the sea to the points of incidence. In corroboration of my theory, I have to remark that, during my last voyage to the Arctic Regions (1850–1), we never, among the numerous icebergs, saw any that were colored, but all were a yellowish white; and during the following winter, the aurora was exactly the same color; and, when that part of the globe was covered with bruised glass of that color, the phenomena produced in my exper-

iment was the same, as was, also, the Aurora Australis, in the Antarctic regions, where no colored icebergs were ever seen. At the time this theory was first promulgated a controversy took place between the celebrated Prof. Schumacher, of Altona, who supported my theory, and the no less distinguished M. Arago, who, having opposed it, sent M. G. Martens and another to Hammerfest on purpose to observe the aurora, and decide the question. I saw them at Stockholm on their return, when they told me their observations tended to confirm my theory; but their report being unfavorable to the expectations of M. Arago, it was never published; neither was the correspondence between the two Professors, owing to the lamented death of Prof. Schumacher. I regret that it is out of my power to exhibit the experiments I have described, owing to the peculiar manner in which the room must be darkened, even if I had the necessary apparatus with me; but it is an experiment so simple that it can easily be accomplished by any person interested in the beautiful phenomena of the Aurora Borealis."

A GALVANIC ACTION IN THE EARTH.

An eminent London cutler (Mr. Weiss of the Strand), to whose inventions modern surgery is under considerable obligations, has remarked that steel seemed to be much improved when it had become rusty in the earth, and provided the rust was not factitiously produced by the application of acids. He accordingly buried some razor-blades for nearly three years, and the result fully corresponded to his expectation. The blades were coated with rust, which had the appearance of having exuded from within, but were not eroded, and the quality of the steel was decidedly improved. Analogy led to the conclusion that the same might hold good with respect to iron, under similar circumstances; so, with perfect confidence in the justness of his views, he purchased as soon as an opportunity offered, all the iron, amounting to fifteen tons, with which the piles of London Bridge had been shod. Each shoe consisted of a small inverted pyramid, with four straps, rising from the four sides of its base, which embraced and were nailed to the pile; the total length, from the point which entered the ground, to the end of the strap, being about sixteen inches, and the weight about eight pounds.

The pyramidal extremities of the shoes were found to be not much corroded, nor, indeed, were the straps; but the latter had become extremely and beautifully sonorous. When manufactured, the solid points in question were convertible only into very inferior steel; the same held good with respect to such bolts, and other parts of the iron-work as were subjected to the experiment, except the straps: these, which, in addition to their sonorousness, possessed a degree of toughness quite unapproached by common iron, and which were, in fact, imperfect carburets, produced steel of a quality infinitely superior to any which, in the course of his business, Mr. Weiss had ever before met with; insomuch, that while it was in general request among the workmen for tools, they demanded higher wages for working it.—These straps, weighing altogether about eight tons, were consequently separated from the solid points, and these last sold as old iron. The exterior difference between the parts of the same shoe,

led, at first, to the supposition, that they were composed of two sorts of iron; but besides the utter improbability of this, the contrary was proved by an examination, which led to the inference that the extremities of the piles having been charred, the straps of iron closely wedged between them and the stratum in which they were imbedded, must have been subjected to a galvanic action. which, in the course of some six or seven hundred years, gradually produced the effects recorded.

ELECTRO-CHEMICAL PAPER FOR TELEGRAPHIC PURPOSES.

M. Maisonneuve has recently presented to the French Academy an electro-chemical paper for telegraphic purposes, which seems to fulfill all the conditions necessary for complete success, which he enumerates as follows: 1st. cheapness; 2d. sufficiently sized to take annotations in ink; 3d. sufficiently humid to be a conductor, yet without excess, so as to receive these annotations; 4th. slightly acid, to increase its conductibility, yet not enough to affect the metals which it touches; 5th. easily decomposable by electricity; 6th. giving, by means of this decomposition, a deep-colored, insoluble and stable salt; 7th. of so simple a composition that it can be prepared at the stations themselves, if found advisable; 8th. not requiring any peculiar kind of paper pulp; 9th. of an easy and simple composition, not requiring the proportions of the salts to be very exact.

The formula for the preparation of this paper is as follows:—Water, 100 parts; crystallized nitrate of ammonia, 150; yellow cyanide of potassium and iron, 5. By using 150 parts nitrate of ammonia this paper acts well in the summer, and without requiring to be kept from the air. A short immersion in water will remove any excess of these proportions. It may be prolonged without injury to the clearness of the characters.

COMPASS VARIATIONS IN THE MERCANTILE MARINE.

Colonel Sabine, of England, in a recent publication on the danger to which vessels are exposed from compass variations, expresses the opinion that in all large ports, at least, in which vessels are equipped, a competent person should be appointed, whose duties should be—to select in every ship an advantageous position for a standard compass, combining the two requisites in such selection of a manageable local attraction, and of convenient access for navigating the ship; to determine experimentally the local deviations of the standard compass in different azimuths; to instruct the master how to repeat the same on future occasions; and to see that he rightly and thoroughly understands the deduction of the true magnetic courses from those of the standard compass, and of the course by the standard compass corresponding to the true course which he desires to steer. The performance of these duties on the part of the person so appointed to be imperative, at least in all cases of iron ships and steamers, by a regulation that no such ship should be permitted to leave the port until a certificate should be produced that they have been duly performed.

MAGNETIC FORCE OF OXYGEN.

M. Becquerel, succeeding Faraday, has also established the fact that oxygen is magnetic, and that atmospheric air, in virtue of the oxygen it contains, partakes of the same property. The mode of experiment to measure the force exercised by a magnet on a gas in comparison with the effect produced upon a body taken as unity, consisted in placing successively small bars of glass, wax, etc., in a vacuum and in different gases, in order to determine the magnetic power of the gas by the difference of effect produced under these two conditions. He thus established that the relation between the attraction of oxygen by a magnet, and the repulsion in an equal volume of water, is proportioned to the density of the gas, and that it is represented by 0·18 at the temperature of 12° Cent. If we reflect that the earth is surrounded by a mass of air equivalent in weight to a stratum of mercury 76 centimetres in height, we can understand that a similar mass submitted to the incessant variations of temperature and pressure, ought to exercise an influence on some of the phenomena dependent on terrestrial magnetism. In calculating what is the real magnetic power of this fluid mass, we find that it is equivalent to an immense shell of iron, of a thickness of $\frac{1}{10}$th of a millimeter, covering the entire surface of the globe. The results of Faraday, Becquerel, and Matteucci, attained by different methods, all agree. M. Plucker having reached other results by a process of his own—a method by weight—Becquerel has renewed his researches, and confirms anew his previous results.

DR. BELL ON THE SO-CALLED "SPIRITUAL PHENOMENA."

We extract from the July number of the American Journal of Insanity the following extract of a paper read by Dr. Bell, of the McLane Hospital, Mass., at the recent meeting of the Superintendents of Insane Hospitals, assembled in Boston. A paper on a similar subject was presented by Dr. Bell at a previous meeting of the Association, held in Washington, D. C., but this, by request of several members, was not reported. They considered that the whole subject was then too immature, and so much connected in the public mind with the ridiculous, as to make it inexpedient that it should be more than announced generally as among the topics discussed by the Association.

Dr. Bell commenced by expressing his surprise in finding last year that at so large a meeting of persons, whose lives were spent in investigating the reciprocal influences of mind and body, scarcely a single member had given a moment's attention to a topic directly in his path, which, whether regarded as merely an epidemic mental delusion, or as a new psychological science, was producing such momentous effects upon the world. It was now said to number over two millions of believers, had an extended literature, a talented periodical press in many forms, and had certainly taken fast hold on many minds of soberness and power. He was well aware how easily it was turned to ridicule, and that there were many who would be ready to ask, when they saw hospital directors seriously discussing the spiritual phenomena. *Quis*

custodiet ipsos custodes? But if there was any class of men who had duties in this direction, it was those of our specialty. Our reports contain the record of many cases of insanity said to have been produced by it. It was important, whether true or false, or mixed, that its precise depth, length. and nature, should be studied out. As is well-known, mystery always loses its terrific character when boldly met, and opened to the light of noon-day. Dr. Bell remarked, that on his return home from the meeting at Washington, he had a peculiar wish to verify his previous observations on what are technically known as the physical manifestations of this new science. He could not pretend to doubt his repeated personal observations, addressed to his sight, hearing and touch, and separated, as he believed, from any possibility of error or collusive fraud. Yet the offer by Professor Henry, of a large sum to any person who would make one of *his* tables move *in* the Smithsonian Institution, and the obvious incredulity of many of the "brethren," had induced the desire again to see some full and unequivocal experiments in *table-moving*. An opportunity was not long wanting. On the occasion of the visit of a well-known gentleman long connected with the insane, and who never had seen any of these phenomena at the Asylum, Dr. Bell invited him to go to a family where a medium of considerable power was visiting. The medium was a young lady of eighteen or twenty, of very slight figure, weighing eighty or ninety pounds, and had discovered herself to be a *medium* while on a visit to these distant relatives. A family, from character and position more entirely beyond the suspicion of even winking at any thing like fraud or irregularity, does not exist in the world. They were so fortunate as to find the medium at home, and the circle was made of five persons. The ordinary manifestations of raps, beating of musical tunes and responses to mental and spoken questions, were very completely presented, as well as the movements of the table under the mere contact of fingers' ends. Finding that things appeared very favorable to a full exhibition of what he wished to see, as evinced by the very facile movements of the table under contact, Dr. Bell proposed trying the grand *experimentum crucis* of the physical manifestations —the movement of the table without any human contact, direct or indirect. He was permitted to arrange things to suit himself, and began by opening the table more widely, and inserting two movable table-leaves, which increased the length from about six to perhaps nine or ten feet. This he felt also gave him an opportunity to see and upset all wires and mechanism concealed, or at least to answer positively as to their non-existence. The table was a solid structure of black-walnut, with six carved legs—the whole of such a weight that, when the castors were all in the right line for motion, he could just start it by the full grasp of the thumb and fingers of both hands. The persons stood on the *sides* of the table, three and two, and back from its edge about eighteen inches. As Dr. Bell is some six feet two inches in height, he averred that he had no difficulty in seeing *between* the table and the persons of all present. The hands were raised over it at about the same height of a foot and a half. At a request the table commenced its motion, with moderato speed, occasionally halting, and then gliding on a foot or two at once. It seemed as if its motion would have been continuous, if the hands above it had

followed along *pari passu*. On reaching the folding-doors, dividing off the two parlors, and which were open, it rose over an iron rod on which the door-trucks traversed, and which projected half or three-quarters of an inch above the level of the carpet. It then entered the other parlor, and went its whole length, until it came near the pier-glass at its end, a center-table having been pushed aside by one of the party to allow its free course. At request, for they during this time spoke as if to actual beings, the motion was reversed, and it returned, until it again reached the iron rod. Here it stuck. The table hove, creaked, and struggled, but all in vain; it could not surmount the obstacle. The medium was then "impressed by the spirits" to write, and, seizing a pencil, hastily wrote that if the fore-legs were lifted over the bar, they (*i. e.* the spirits) thought they could push the others over. This was done, and the motion kept on. Once or twice Dr. Bell requested all to withdraw a little further from the table, "to see how far the influence would extend." It was found that, whenever a much greater distance, say two feet, was reached, the movement ceased, and a delay of three or four minutes occurred before it recommenced, giving the idea that, if broken off, a certain re-accumulation of force was needful to put it in motion again. The table reached the upper end of the parlor, from which it had started, but was left some four feet from the median line of the room. Dr. Bell expressed the thanks of the company for the very complete exhibition with which they had been favored, but remarked that the obligation would be enhanced if the "spirits" would move the table about four feet at right-angles, so that the chairs would come right for their late occupants. This was immediately done, and the performance was deemed so perfectly full and satisfactory, that nothing more was asked at this session. Dr. Bell was understood to say that this made some five or six times in which he had seen the table move without human contact, and all under circumstances apparently as free from suspicion as this just related.

Dr. Bell mentioned that, in his last experiment—that just narrated—the entire space moved through was over fifty feet. Dr. Bell then passed to the topic of responses to mental and verbal questions, and gave several narratives of long conversations with what purported to be the spirits of persons dead for twenty-five to forty years, in which every question he could devise relating to their domestic history and to events in it, known only to them and him, had been truly answered. Some of the subjects put mentally—*i. e.* without speaking or writing—had half a dozen correct replies, forbidding of course completely on any doctrine of chances, the contingency of accident or coincidence, as such *mental* questions, *per se*, negative the explanation of previous knowledge on the part of the medium. A brief abstract of one of these will give a general idea of their character. Dr. Bell had frequently remarked to his "spiritual" friends that if any medium could reproduce the essential particulars of a final interview which had occurred between himself and a deceased brother, in 1826, he should be almost compelled to admit that it came from his spirit, because he was sure that he (Dr. Bell) never had communicated it to any living being. Hence as it had never been known to but two persons, and was of so peculiar, well-marked a character, as not to be capable of being

confounded by generalities, he should hardly be able otherwise to explain it. A few weeks afterward, what purported to be the spirit of that brother narrated the essential particulars of the interview, the place where, down to the well-recollected fact *that he was adjusting the stirrups of his horse*, preparatory to a distant journey, when it was held! Pretty early, however, in his investigations, Dr. Bell began to find that, however correct his spiritual conferees were in most of their responses, the moment a question was put involving a response the truth of which was unknown to him, uniform failure occurred. Sometimes when he believed at the time that his questions were truly answered, subsequent information had shown him that he had been mistaken. He had answers which he believed to be true, when the facts were decidedly otherwise. Pursuing this train of inquiry, he found the "spirits," while averring that they could see him distinctly, "face to face," never could read the signatures taken from an old file, and unfolded *without his having seen the writing*. Yet as soon as he had cast his eye upon the signature, without allowing any one else to see it, it was promptly and correctly reproduced by the alphabetical rappings. And again, when he had made a previous arrangement with his family that they should do certain things every quarter of an hour at home—he, of course, not knowing what—while he was to ask the "spirit" what was done at the instant, uniform failure occurred. He proved, too, that the theory of the "Spiritualists" to meet such difficulties, viz.: that evil or trifling spirits interfered at *their* end of the telegraph—was not tenable. For the responses just before and after these gross failures had been eminently and wonderfully accurate, and the "spirits" not only declared that they saw with perfect clearness what was going on at his house, but denied that there had been any interruption or interference. Dr. Bell also gave examples where test questions, involving replies *unknown* to the interrogator, had been designedly intermixed with those which were known. The result uniformly was that the known responses, however curious and far remote, were correctly reproduced; the unknown were a set of perfectly wild and blundering errors, the responses often being obviously formed out of the phraseology of the question, as a *stuck* school-boy guesses out a reply! The result of the inquiries of Dr. Bell and his friends—for several gentlemen of eminently fitting talents pursued the investigation with him—was briefly this: *that what the questioner knows, the spirits know; what the questioner does not know, the spirits are entirely ignorant of.* In other words, that there are really no superhuman agencies in the matter at all—no connection with another state of existence; but that it bears certain strong analogies to some of the experiences of *clairvoyance*, in that mysterious science of animal magnetism, as it has been protruding and receding for the last hundred years. Dr. Bell thought there was some reason to believe that the matter reproduced may come not only from the questioner, but if in the mind of any one at the circle, that it might be evolved. He made some observations upon the evidences of spirit existence, drawn from the character of the matter communicated by the mediums in a state of *impression*, when, as is believed, spirits express themselves through the human agent. Of course, the quality of such composition is more or less a question of taste. Much of it is elevated, indicating high intellectual and

moral capacities in the mind to which it owes its origin. Much more is absurd, puerile and disgusting, infinitely below the grade of the human productions of the same persons from whom it professedly comes. Yet the spiritual revelation has given us nothing of such extraordinary value or novelty as to stamp it, in the judgment of unprejudiced minds, as of supermundane production. Dr. Bell alluded to a treatise which had been put into his hands by an earnest spiritualist, purporting to be the work of Thomas Paine, the author of "The Age of Reason," etc., which was thought would carry conviction to any body, as it purported to be a full explanation of the formation and changes of this earth by one who, from his *situs*, must know all about it. The truth was that the work was the production of some mind, celestial or mundane, ignorant of the very first rudiments of chemical philosophy, in which the most ridiculous blunders were made on every page in matters which are as demonstrable as mathematics, and where, of course, the answer can not be made that the revelation was too high for common readers. Nor does Dr. Bell believe, from his observations, that the waters from this fountain ever reach a higher level than their source. The most elevated specimen of the spiritual literature would no doubt be found in the communications from Swedenborg and Lord Bacon, in Judge Edmond's and Dr. Dexter's first and second volumes. Yet whoever reads the very elegant and powerful preliminary treatises of these gentlemen, which Dr. Bell thought would compare favorably with any writings of the kind ever published, would not be able to feel that Swedenborg and Lord Bacon, after their nearly one and more than two centuries' residence respectively, amid the culture and refined senses of the superior spheres, had more than equaled their unpretending amanuenses still in "the vale of tears." Dr. Bell concluded by the expression of his full conviction that, while the faith in spirits must be given up as being connected with these facts, it was a topic, whether regarded as a physical novelty, or even as a delusion, cutting deeply into the very religious natures of our people, which was worth our fullest examination. *There were great, novel, interesting facts here.* They had not been treated fairly and respectfully as they should have been. The effect was that the community knowing that here were *facts*, if human senses could be trusted at all, went away from those who should have thrown light upon the mysteries, but who would or could not, to those who gave some explanation, even if it was one which uprooted all previous forms of religious faith. He hoped that the members of this Association, who were as much required to examine this topic as any order of men except, perhaps, the clergy, would not be afraid of looking it in the face from any apprehensions of ridicule or of degrading their dignity.

Dr. Gray inquired if there were any perceptible effects produced upon the feelings or health of the mediums by the exercise of this power.

Dr. Bell replied that his inquiries of them led him to suppose that there were no palpable influences from this cause.

Dr. Cutler wished to know if Dr. Bell supposed that the medium was conscious of what was passing in the mind of the questioner.

Dr. Bell thought such was not the case. The mediums all concur (and

many of those in private life, at least, are of the highest worth—and, indeed, he believed that many of those who gratified those interested by paid sessions to be no less worthy) in declaring that they have no consciousness of any participation in what is going on before them. Nor could he see, in the temperaments or other indications of the mediums, any thing in common. They ran through a wide expansion of intelligence, from Judge Edmonds down to the most moderate intellectual development.

Dr. Cutler inquired how Dr. Bell supposed the raps to be made.

The doctor admitted his entire inability to suggest how, any more than why the magnetic needle should insist upon turning toward the north instead of S.S.E.

Dr. Bell remarked that there was a great number of very curious facts connected with the various branches into which these phenomena had run off, which he had not time to enter into the consideration of. He considered them all as of less intense interest that the great question of the veritable existence of the "*spirits.*" The *trance* speaking, the impressions of a visual panoramic order, the composition of all sorts of prose and poetry, the curious "spirit-drawings," and still other manifestations; of some of them it is very difficult to make an explanation; others may hereafter be found in the class of hysterico-nervous excitements, in which the individual, without any intention to deceive, is so wrapped up in an internal flow of fancies as to lose consciousness of external things; yet the intellectual process goes on. Still other phenomena may perhaps be proved to be connected with the duality of the brain. It is undoubted that that organ is like the ear and eye, each of which is one of two symmetrical duplicates. When both act concurrently, but one class of effects is produced. When the ear or eye becomes dislocated from its fellow, double vision and disturbed audition result. One eye may be habitually passive, as seems to be one perfect optics of the cross-eyed, and the attention is not called to the images which it presents, although these images may be all distinctly pictured on the retina, and may, by some association or diseased action, be subsequently reproduced. The analogy of the brain to these facts is shown in the phenomena of dreaming, when we do and say and think things which are utterly foreign to our habitual feelings and views, as much as one mind could vary from another. Or, again, it is illustrated in not unfrequent examples of periodical mania, where, for a period of weeks, or months, or years, the patient lives in a certain state of moral, intellectual, and affective existence, perfectly unlike the other remnant of his life. Were a new guide or governor known to enter the sensorium and assume the reins, a more completely distinct set of results could not be expected. In inebriety the same facts exist. The phenomena of impressions made upon an organ, and afterward reproduced on disease, are common in the books.

Dr. Bell admitted that many of the responses made by the purporting "spirits" of your friends are so odd and unnatural, as compared with your own thoughts or manner of speech, as to make it difficult to believe that they ever came from your own habitual brain—that is, that part of your brain which you recognize as responsible to your own individuality. He related an incident illustrative of his meaning. He was once attending a session, or

circle, where his position was at the bottom of a long table, at the head of which the "medium" sat, and on each side of her were some other persons. All had paper and pencils in hand to minute down the responses, etc. Owing to some "want of harmony" or other cause, the "spirits" failed in correct replies, and a good deal of confusion and repetition occurred. Often their reply through the alphabet was, "we don't know," "we can't tell," etc. Dr. Bell was amusing himself, under these delays, in drawing with his pencil a grotesque figure of an imaginary animal—a sort of griffin with horns, tusks, etc. After one of the replies of the "spirits" that they "did n't know," the doctor rather pettishly lifted his pencil from the paper, and said, "Well, do you know what this is?" The response was at once rapped out, "It is hard naming that beast!" As he was in a position where no eye could overlook him, and where no person beside himself could know what was drawn, he was at a loss to know out of whose brain, except his own, the quick repartee could originate. He certainly had no consciousness of it. Dr. Bell also mentioned other cases where the idea in the questioner's mind was reproduced, but in different phraseology from that he held. A "spirit," for example, was asked where she had been buried. The answer was *St. Augustine.* The letter S was first rapped: he waited at A, having no idea that the contraction would be used, but *it was*, the rap being made at T.

Dr. Nichols inquired whether Dr. Bell had any further experiences and observations in the curious *inverted reverse* handwriting, of which he had given an account last year.

Dr. Bell replied that he understood that that phenomenon of handwriting, where the pencil began at the *last* part of the *last* letter of the *last* word of the *last* sentence, and run back rapidly to the beginning, being also *upside down* to the writer, was not uncommon, although he had not again met with it. In one instance in his experience lately, the medium wrote in a reversed manner, so that the writing could be read in a mirror, or by being held up to the light, back to the reader—an obviously very easy thing as compared with that just described.

Dr. Bell had seen many of the "spirit-drawings," which seemed like incongruous grotesque specimens of Chinese art—flowers, fruit, and leaves being aggregated against all the precedents of nature or laws of botanical philosophy. They were only remarkable from being the production of persons unskilled in the use of the pencil, as was declared to be the case. Dr. Bell concluded by remarking that he regarded the question, whether the spirits of the dead had any thing to do with these phenomena, to be so much more important, in a practical point of view, than any other minor facts connected with them, that he had pretermitted much of his attention to these curious incidents, in order to direct his investigations more to the other point, the result of which he had endeavored to give.

CONSTITUTION OF THE SUN—SOLAR MAGNETISM.

Mr. Thomson, one of the physicists who, with Carnot, Joule, Meyer, and others have largely contributed toward establishing the relations between heat

and mechanical force, has extended his researches to the heat emitted by the sun; and he observes that this heat corresponds to a development of mechanical force, which, in the space of about 100 years is equivalent to the whole active force required to produce the movement of all the planets. The author examines successively the different sources of heat, and ends by concluding that the solar heat can have no other than a meteoric origin, and that it results from the motion of meteors which fall into the sun—an idea first put forth by Mr. Waterson at the meeting of the British Association at Hull. Whatever may be the value of this hypothesis, we would ask whether it would not be more simple to admit that the solar heat proceeds simply from the rotatory movement of the sun. Mr. Thomson admits himself that the rotation is necessary to the production of the heat. It is known that the sun moves on its axis, and what use is this invention of meteorites, which nothing justifies? This idea of deriving heat from motion, which was rejected more than thirty years ago, suggests the hypothesis which assigns an analogous origin to terrestrial, and hence to planetary magnetism. The question of solar magnetism has been conclusively settled by the researches of M. Secchi, director of the observatory at Rome. The sun, which is a source of light, and a source of heat, is then a source of magnetism also—heat, light, electricity, and magnetism have then a common origin—matter in motion.—*M. Nickles, Paris Correspondence Silliman's Journal.*

FARADAY ON THE NATURE OF GRAVITY AND PHYSICAL FORCE.

It is probably of great importance that our thoughts should be stirred up at this time to the reconsideration of the general nature of physical force, and especially to those forms of it which are concerned in actions at a distance. These are connected very intimately with those which occur at insensible distances; and it is to be expected that the progress which physical science has made in later times will enable us to approach this deep and difficult subject with far more advantage than any possessed by philosophers at former periods. At present we are accustomed to admit action at sensible distances, as of one magnet upon another, or of the sun upon the earth, as if such admission were itself a perfect answer to any inquiry into the nature of the physical means which cause different bodies to affect each other; and the man who hesitates to admit the sufficiency of the answer, or of the assumption on which it rests, runs some risk of appearing ridiculous and ignorant before the world of science. Yet Newton, who did more than any other man in demonstrating the law of action of distant bodies, including among such the sun and Saturn, which are nine hundred millions of miles apart, did not leave the subject without recording his well-considered judgment, that the mere attraction of different portions of matter was not a sufficient or satisfactory thought for the philosopher. That gravity should be innate, inherent, and essential to matter, so that one body may act upon another at a distance through a vacuum without the mediation of any thing else, by and through which their action and force may be conveyed from one to another, is, he says, to him a great absurdity. Gravity must be caused by an agent acting constantly ac-

cording to certain laws; but whether this agent be material or immaterial he leaves to the consideration of his readers. This is the onward-looking thought of one who, by his knowledge and like quality of mind, saw in the diamond an unctuous substance coagulated when as yet it was known but as a transparent stone, and foretold the presence of a combustible substance in water a century before water was decomposed or hydrogen discovered; and I can not help believing that the time is near at hand when his thought regarding gravity will produce fruit; and, with that impression, I shall venture a few considerations upon what appears to me the insufficiency of the usually accepted notions of gravity and of those forces generally which are supposed to act at a distance, having respect to the modern and philosophic view of the conservation and indestructibility of force.

The notion of the gravitating force is, with those who admit Newton's law, but go with him no further, that matter attracts matter with a strength which is inversely as the square of the distance. Consider then a mass of matter (or a particle), for which present purpose the sun will serve, and consider a globe like one of the planets, as our earth, either created or taken from distant space and placed near the sun as our earth is; the attraction of gravity is then exerted, and we say that the sun attracts the earth, and, also, that the earth attracts the sun. But if the sun attracts the earth, that force of attraction may either arise *because* of the presence of the earth near the sun, or it must have pre-existed in the sun when the earth was not there. If we consider the first case, I think it will be exceedingly difficult to conceive that the sudden presence of our earth, ninety-five millions of miles from the sun, and having no previous physical connection with it, nor any previous physical connection caused by the mere circumstance of juxtaposition, should be able to raise up in the sun a power having no previous existence. As respects gravity, the earth must be considered as inert, previously, as the sun, and can have no more inducing or affecting power over the sun than the sun over it. Both are assumed to be without power in the beginning of the case; how then can that power arise by their mere approximation or co-existence? That a body without force should raise up force in a body at a distance from it, is too hard to imagine; but it is harder still, if that can be possible, to accept the idea when we consider that it includes the *creation of force.* Force may be opposed by force, may be diverted, directed partially or exclusively, may even be converted, as far as we understand the matter, disappearing in one form to unite in another; but it can not be created or annihilated, or even suspended, *i. e.*, rendered existent without action, or without its equivalent action. The conservatism of power is now a thought deeply impressed upon the minds of philosophic men; and I think that, as a body, they admit that the creation or annihilation of force is equally impossible with the creation or annihilation of matter. But if we conceive the sun existing alone in space, exerting no force of gravitation exterior to it, and then conceive another sphere in space, having like conditions, and that the two are brought toward each other; if we assume that by their mutual presence each causes the other to act, this is to assume not merely a creation of power, but a *double creation,* or both are supposed to arise from a previously inert to a powerful state. On

their dissociation they, by the assumption, pass into the powerless state again, and this would be equivalent to the *annihilation* of force. It will be easily understood that the case of the sun and the earth, or of any one of two or more acting bodies is reciprocal, and also that the variation of attraction, with any degree of approach or separation of the bodies involves the same result of creation or annihilation of powers as the creation or annihilation of either of the acting bodies would do.

Such, I think, must be the character of the conclusion, if it be supposed that the attraction of the sun upon the earth arises *because* of the presence of the earth, and the attraction of the earth upon the sun because of the presence of the sun; there remains the case of the power or the efficient source of the power having pre-existed in the sun (or the earth) before the earth (or the sun) was in presence. In the latter view it appears to me that, consistently with the conservation of force, one of three sub-cases must occur; either the gravitating force of the sun, when directed upon the earth, must be removed in an equivalent degree from some other bodies, and when taken off from the earth (by the disappearance of the latter), be disposed of on some other bodies; or else it must take up some *new* form of power when it ceases to be gravitation, and consume some other form when it is developed as gravitation; or else it must be *always* existing around the sun through infinite space. The first sub-case is not imagined by the usual hypothesis of gravitation, and will hardly be supposed probable; for if it were true, it is scarcely possible that the effects should not have been observed by astronomers, when considering the motion of planets in different positions with respect to each other and the sun. Moreover, gravitation is not assumed to be a dual power, and in them only as yet have such removals been observed by experiment or conceived by the mind. The second sub case, or that of a new or another form of power, is also one that has never been imagined by others, in association with the theory of gravity. I made some endeavors, experimentally, to connect gravity with electricity, having this very object in view, but the results were entirely negative. The view, if held for a moment, would imply that not merely the sun, but all matter, whatever its state, would have extra powers set up in it, if removed in any degree from gravitation; that the particles of a comet at its perihelion would have changed in character, by the conversion of some portion of their molecular force into the increased amount of gravitating which they would then exert; and that at its aphelion this extra gravitating force would have been converted back into some other kind of molecular force, having either the former or a new character; the conversion either way being to a perfectly equivalent degree. One could not even conceive of the diffusion of a cloud of dust, or its concentration into a stone, without supposing something of the same kind to occur; and I suppose nobody will accept the idea as possible. The third sub-case remains, namely, that this power is always existing around the sun and through infinite space, whether secondary bodies be there to be acted upon by the gravitation or not; and not only around the sun, but around every particle of matter which has existence. This case of a constant necessary condition to action in space, when as respects the sun the earth is *not* in place, and of

a certain gravitating action as the result of that previons condition when the earth *is* in place, I can conceive consistently, I think, with the conservation of force; and I think the case is that which Newton looked at in gravity, and is in philosophical respects the same as that admitted by all in regard to light, heat, and radiant phenomena; and in a more general sense is forced upon our attention by the phenomena of electricity and magnetism, because of their dependence on dual forms of power.

PENDULUM EXPERIMENTS FOR THE DETERMINATION OF THE EARTH'S DENSITY.

Professor Airy, the Astronomer Royal, recently delivered a lecture before the Royal Institution, "On the Pendulum Experiments lately made in the Harton Colliery, for ascertaining the Mean Density of the Earth." He commenced by explaining the importance in astronomical investigations of acquiring a correct knowledge of the mass of the earth, as the means of determining the force of gravitation and the density of other planetary bodies, and then noticed the different plans which had been adopted to ascertain the mean density of the earth, including the attraction of a plummet to the side of the mountain Schechallian, and known as the Schechallian experiment; Mr. Cavendish's cabinet experiment, in which he had attempted to arrive at the same result by the attractions of large spheres of lead on light bodies; and the pendulum experiments which, with the assistance of Dr. Whewell, Professor Airy had made in 1826, and again in 1828, in the Dolcoath Mine, in Cornwall. Both those experiments were failures, for in each case, after many days of persevering toil and observation, unforeseen accidents injured the instruments, and prevented the attainment of any satisfactory results. Professor Airy minutely explained the principle on which the vibration of a pendulum depends, and on which the pendulum experiments were contrived to determine the density of the earth. As the rapidity of the vibration of the pendulum increases with the increase of the force that attracts it downward, it was expected that by noting accurately the number of vibrations in a given time on the surface and at the bottom of a deep mine, the difference would afford a measure of the relative attractions of gravitation at the two points. In those early experiments the great difficulty experienced was in ascertaining precisely the correspondence or difference in the vibrations of the pendulums placed at the top and at the bottom of the mine, which was attempted to be done by means of a chronometer. The recent application of voltaic electricity in the Observatory at Greenwich had suggested a ready mode of noting the variations of the pendulums, and the Astronomer Royal, therefore, with this new power at command, determined to repeat the experiments. With the assistance of a numerous staff of observers, drawn from the different observatories in the kingdom, he commenced operations in the Harton Colliery, near Newcastle, which is 1,600 feet deep. The Electric Telegraph Company gave their aid in laying down insulated wires, and, by means of a clock, to make and break contact with the voltaic battery, galvanometers at the bottom and at the top of the pit made simultaneous deflections every fifteen seconds. Several ob-

servations were made in varied forms, each one being continued for 104 hours, and the correspondence between them was so exact as to leave no doubt of the accuracy of the experiments. The results showed a difference of two seconds and a quarter in 24 hours between the pendulum at the lower point and that at the mouth of the pit, the lower one having gained that much in consequence of the greater attraction of gravitation. Professor Airy said it could be mathematically demonstrated that the counteracting attraction of the shell of the earth above the pendulum would be exactly neutralized by the attraction of the same thickness of matter in other parts of the sphere, so that the actual force of gravitation acting on the pendulum would be represented by the mass beneath, not including the shell, of 1600 feet. All the requisite computations have not yet been made, but sufficient has been done to ascertain that the mean density of the earth is greater than the estimated density by the Schechallian experiment. By that experiment it appeared that the mean density is between five and six times the specific gravity of water, while the pendulum experiments make it between six and seven times more dense.

Pendulum Detachment.—An ingenious and novel pendulum detachment for church clocks has been invented by J. R. Brown, of Providence, R. I. This arrangement, illustrated with diagrams, may be found described in the *Scientific American*, February 10th, 1855.

ON SOLAR REFRACTION.

Among other interesting and important consequences of the dynamical theory of heat, Professor W. Thomson having deduced the necessity of a resisting medium, the condensation of this about the sun, and a consequent refraction of the stars seen in that neighborhood, Professor Piazzi Smyth has endeavored to ascertain, by direct astronomical observation, whether any such effect was sensible to our best instruments. Owing to atmospheric obstructions, only three observations, yielding two results, had been yet obtained; but both these indicated a sensible amount of solar refraction. Should this effect be confirmed by more numerous observations, it must have important bearings on every branch of astronomy; and as the atmosphere at all ordinary observatories presents almost insuperable obstacles, the author pointed out the advantage of stationing a telescope for this purpose on the summit of a high mountain.—*Prov. British Association.*

COLOR BLINDNESS.

This term is applied to an inability to distinguish different colors. It includes all varieties and degrees of the affliction. In some cases there is total blindness to colors, the distinction of black and white alone being perceived. More frequently there is inability to discern a single color, such as red, or inability to distinguish between two colors, such as red and green. A work on this subject has recently been published by Dr. George Wilson, of England, in which he takes occasion to point out the danger attending the present sys-

tem of rail-way and marine colored signals. Dr. Wilson has collected a great number of new and well authenticated facts on all branches of the subject. The frequency of the affection appears to be far greater than had previously been suspected. The experience of the well-known oculist of Glasgow, Dr. Mackenzie, that in forty thousand cases of eye-disease treated by him he had met with only two cases of color-blindness, does not invalidate other statements as to its frequency. He may not have often directed his inquiries to the point, and possibly the physical condition of the eye producing this affection renders it less sensitive and liable to other complaints. Dr. Wilson estimates, from his own observations and inquiries, the per centage of color-blind persons in the community as high as one in twenty, and strongly marked cases about one in fifty.

COLOR IN NATURE AND ART.

Frames of pictures in general are no better than necessary evils; for, if they are requisite to isolate a picture from surrounding objects, yet it must be confessed that the contiguity of the frame to the picture is exceedingly detrimental to the illusion of perspective. It is this which explains the difference between the effect of a framed picture, and the effect of the same picture when viewed through an opening which allows of our seeing neither frame nor limits. The effect then produced recall all the illusion of the diorama. In the case of not a few pictures, taste is best shown in knowing *how little* frame is necessary. The color of the wall, and nature of surrounding objects, must be considered in judging of this. We once saw a painting by a German artist, representing the interior of a Gothic ruin, with a snowy landscape visible through the open archway of the door, and some snow, drifted in, lying upon the steps and stone floor inside. The perspective was exquisite—magical; and the drifted snow upon the steps and floor seemed as if you could lift it off with a knife. The picture was in the possession of an able connoisseur—and how had he treated it? Most people would have put round it a frame proportionate to the value of the picture; that seems to be the usual way—so many inches of frame to a £20 picture, and so many more to one worth £100. Not so with this connoisseur. When we saw it, this gem of a painting had round it a simple, narrow bead of gilding, and was hung upon a wall of an orange-cream color—the unobtrusive frame, allowing the exquisite perspective to appear to advantage, while the peculiar color of the wall served to bring out, in all its brilliance, that other fine point in the piece, the snow.

With this warning against having too much frame—which we can not, of course, shape into any definite axiom, but which will answer the purpose if it make people think at all upon the subject—we proceed to consider the relation of color which ought to exist between a frame and the picture which it surrounds. Gilt frames are, of all others, the handsomest and most generally applicable, and are especially suited for large paintings in oil. Many landscape-paintings in oil are well set off by a gray frame, particularly if we take a gray tinted with the complementary (or opposite) of the dominant color

of the picture. For black engravings and lithographs, gilt frames suit perfectly, provided a certain breadth of white paper be left round the subject. frames of yellow wood, such as bird's-eye maple, etc., likewise accord well with lithographs; and it is possible greatly to modify the appearance of the drawing by mounting it on tinted paper, when we do not desire the effect of a white margin.

As to the hanging of pictures in a room, we only repeat the general canon when we say that engravings and plain lithographs should not be placed beside oil-paintings or colored drawings. When we wish to place pictures upon a papered wall, the latter ought to be of a single color, if possible—if not, of two tones of the same color, and with a simple pattern. Also, the dominant color of the paper-hangings ought to be complementary to the dominant color of the picture. Pearl-gray, or normal-gray a little deeper, is a good tint to receive engravings and plain lithographs in gilt or yellow wood frames. Yellow hangings can receive with advantage landscapes in which greensward, and leaves, and a blue sky predominate; and the most suitable frames in this case are those of violet-colored ebony (*palixandre*) or wood painted gray or black. Oil-paintings, in gilt frames, are effective on walls of olive-gray; upon which ground the flesh-colors of the picture, and the gold of the frame, assort well. Paper of a deep green, and even of a deep blue, may likewise be advantageously employed in many cases. We know one artist, whose drawing-room wall, covered with oil-paintings in gilt frames, has a flock-paper of deep green, the velvet pattern being of nearly equal extent with the smooth ground, but of a darker shade. The effect is very good. Had it been a picture-gallery, the paper would have been unquestionably better if of a perfectly uniform color; but, by having it patterned, and of two shades of the same color, the requirements of a drawing-room are answered with the least possible detriment to the effect of the pictures.

So much for the mechanical accessories of the Fine Arts, whether these be exhibited in a noble gallery, or in the houses of our middle-classes. In coming to the furniture of our dwellings, it must be confessed that, so innumerable are the possible combinations of color, it is impossible to lay down many laws of general application. In large rooms, bright, contrasting colors may be employed; whereas, in small rooms, the harmony should be not of contrast, but of analogy; in other words, the furniture of small rooms should in general have but one predominant color, and the contrasts exhibited be only those of tone. On this principle, hangings, with varied and brilliant colors, representing flowers, birds, human figures, landscapes, etc., may be employed in the decorating of large rooms; whereas, chintzes are only suitable to small rooms, such as cabinets, boudoirs, etc. In bed-rooms, the window-curtains and those of the bed should be similar; and, if there be a divan, it may be similar also; for, we may remark, that it is conformable with the object of boudoirs and similar places, to diminish their extent to the eye, by employing only one material for the hangings and chairs, instead of seeking to fix the eye upon many separate objects.

Of hangings—and our remarks are almost equally applicable to the general tone of a room—we may say that in consequence of an apartment never

being too light, since we can diminish the day-light by means of blinds and curtains, it is best that the hangings be of a light and not of a dark color, so that they may reflect light rather than absorb it. Dark hangings, therefore, are proscribed, whatever be their color. Red curtains are to be met with very frequently in this country; yet it must be said that red and violet, even in their light tones, ought to be proscribed, because they are exceedingly unfavorable to the color of the skin. Orange can never be much employed, it fatigues the eye so much by its intensity; and, indeed, among the simple colors there is scarcely any which are advantageous, except yellow, and the light tones of green and blue. Yellow is lively, and combines well with mahogany furniture, but not generally with gilding. Light-green is favorable, both to gilding and to mahogany, and also to complexions, whether pale or rosy. Light-blue is less favorable than green to rosy complexions, especially in day-light; it is particularly favorable to gilding, associates better than green with yellow, or orange-colored woods, and does not injure mahogany. White hangings, or hangings of a light gray, either normal, or tinged with green, blue, or yellow, uniform, or with velvet patterns, similar in color to the ground, are also good for use.

In regard to the draping of floors, it must be borne in mind, that for a carpet to produce the best possible effect, it is not enough it is of the best manufacture, and of excellent colors and pattern; it is also requisite that its pattern be in harmony with the size, and its colors with the decorations of the room. It is important for manufacturers to know how to produce carpets which will suit well with many different styles of room furniture; and, in our opinion, the best mode for attaining this end is, to make the light and bright coloring commence from the center of the carpet; for it is there (that is to say, in the part most distant from the chairs, hangings, etc.) that we can employ vivid and strongly-contrasted colors without inconvenience. And if we surround this bright central portion with an interval of subdued coloring, we shall be able to give to the framing-colors (those around the margin of the carpet) a great appearance of brilliance, without injuring the color of the chairs and hangings. With respect to the carpets of small or moderately-sized rooms, we may lay down the rule that the more numerous and vivid the colors of the furniture, the more simple should be the carpet alike in color and pattern—an assortment of green and black having, in very many cases, a good effect. On the other hand, if the furniture is of a single color, or if its contrasts consist only of different tones of the same color, we may, without detriment, employ a carpet of brilliant colors, in such a way as to establish a harmony of contrast between them and the dominant hue of the furniture. But if the furniture is of mahogany, and we wish to bring out its peculiar color, then we must not have either red, orange, or scarlet, as a dominant color in the covering of the floor.

The covering of chairs may present either a harmony of contrast or a harmony of analogy with the hangings, according as the room is large or small; and a good effect may be produced by bordering the stuff at the parts contiguous to the wood with the same color of the hangings, but of a higher tone. Nothing, we may add, contributes so much to enhance the beauty

of a stuff intended for chairs, sofas, etc., as the selection of the wood to which it is attached; and, reciprocally, nothing contributes so much to augment the beauty of the wood, as the color of the stuff in juxtaposition with it. In accordance with the principles of coloring, which we laid down in a preceding part of this article, it is evident that we must assort rose, or red-colored woods, such as mahogany, with green stuffs; yellow woods, such as citron, ash-root, maple, satin-wood, etc., with violet or blue stuffs; while red woods likewise do well with blue grays, and yellow woods with green grays. But in all these assortments, if we would obtain the best possible effects, it is necessary to take into consideration the contrast resulting from height of tone; for a dark blue or violet stuff will not accord so well with a yellow wood as a light tone of these colors does; and hence, also, yellow does not assort so well with mahogany as with a wood of the same color, but lighter. There is no wood more generally used by us than mahogany, and no covering for sofas and chairs more common than a crimson woolen stuff; and in this we are influenced not so much by any idea of harmony, as by the twofold motive of the stability of the crimson color and the beauty of the mahogany. In assorting these, we will often do well to separate the stuff from the wood by a cord or narrow galloon, of yellow, or of golden yellow, with gilt nails; or, better still, a narrow galloon of green or black, according as we wish the border to be more or less prominent. The red woods always lose a portion of their beauty when in juxtaposition with red stuffs. And hence it is that we can never ally mahogany to vivid reds, such as cherry-color; and more particularly to orange reds, such as scarlet, nacarat, and aurora; for these colors are so bright, that, in taking away from this wood its peculiar tint, it becomes no better than oak or walnut. Ebony and walnut can be allied with brown tones, also with certain shades of green and violet.—*Horticulturist.*

SUBSTITUTE FOR THE CAMERA LUCIDA.

The following description of a new instrument for drawing objects or landscapes in correct perspective was read before the Scottish Society of Arts, by the Rev. W. Taylor:

This apparatus consists of a wooden box, 15 by 12 inches, and 1 inch deep. The lid is made, when open, to stand at right angles, and fixed there. On the opposite side of the box a slip of wood is fixed, having a hole at the top, through which the eye looks at the object to be copied. Opposite to this, parallel tubes are fixed upon the open lid of the box, operating as a photograph. At the upper end of the parallel tubes is a hole through which the eye sees the object to be copied, and this orifice is made to travel along the outline of the object. The other end of the parallel tubes has a pencil fixed in it, which is pressed by a spring to a piece of paper fastened to the inside of the lid by button-pins, and which accordingly traces the outline of the object, being the counterpart of the object itself, traced by the other end of the parallel tubes. By means of this instrument, the author stated that any object or landscape could be more correctly copied than by

the camera lúcida, or any other instrument known to him; that a few trials will be found sufficient to enable a person to use the instrument; and that it has the advantage of being portable, easily made, not difficult to use, and not expensive.

ON THE PHYSIOLOGY OF SIGHT.

The following is an abstract of a communication presented to the American Association, Providence meeting, by Dr. T. C. Hilgard: He commenced by alluding to the faculty which the eye has of accommodating itself to different distances—of adjusting its focus. This consists not in any rounding out of the cornea for near objects, or by any motion of the lens, as has been laid down, but, as Dr. Graefe has lately proved, in a lateral compression of the eyeball, so as to give it greater depth. It has to be drawn out for near objects just as any other spyglass is. If any body will hold this print as closely to his eye as possible, and make it distinct, he will feel a constriction of the eyeball. The scope of sight, therefore, depends on the refractive power of the cornea and the lens, and the casual shape of the bulb. Distinctness and indistinctness of vision depend on a certain anatomical organization of the retina, by which images under a certain size are not perceived; on the power of the center of the retina to distinguish forms more keenly than the outer portions; upon whether the retina is in focus or not; upon the Y-formed arrangement of the fibers of the lens, which often makes one see stars when he does not bump his head; upon the width of the pupil as the lateral part of the lens do not unite rays into an exact focus; upon the meeting of the axes of the two eyes, for when both eyes are looking at one point, all objects, further or nearer, appear double, as they are not cast on the corresponding places of the two eyes; and upon the condition of the light arriving, which is so serene on Alpine heights that black letters 1,500 feet high, set up against snow-fields 40 miles distant, might be as easily read as letters one-twentieth of an inch in height at the distance of 8 inches, the angle being the same. We have therefore a scope of distinct sight equal, within all distances to which the eye can accommodate itself, for objects subtending the same angle. We have one limit of most minute vision, namely, as near as an object can be borne, and also a comfortable distance for long-continued minute vision, such as reading. Physiologists are still wondering why we see things upright, when the image on the retina is upside-down, just as in a camera-obscura. The truth is that we do not consciously perceive the image; we only perceive by it, and our ideas of position are formed by the sense of touch. The new-born infant has no clear vision; at most it perceives only light and darkness; but it feels, and feeling is its only available sense; it first becomes aware of the position and form of things by feeling. And so, when we come to see, we think that sight goes out and touches the objects that we see, and we say with all the rest of the world, "As far as the eye can *reach*." The fiery rings which are seen when the eyes are pressed, although formed in the eye, seem to be several inches before it. Persons who are born blind acquire a most perfect knowledge of position by touch, and on receiving sight, immediately perceive things upright. So, standing on the head alters nothing in our ideas

of up and down, and astronomers and microscopists are not aware that they see things reversed. We have also no consciousness of the absolute or even relative size of the image on the retina, since an object looks no larger at the distance of 1 foot than of 10, although the image is 100 times as large. The idea of size is a functión of judgment, of reference to touch. After referring to the law of complementary colors, Dr. Hilgard stated that while the central part of the retina can distinguish forms most distinctly, the eccentric portions seem most susceptible to intensity of light and quality of color. This every one will recognize who has noticed that a faint star may be seen by looking at some point near it when it can not be seen by looking immediately at it. So, gazing at a faded sunset directly, it appears faintest. But turning the head sideways, or up or down, while the eye still looks at the sunset, will cause an increase of light and color. The same result is obtained by pressing the eyes or inclining the head sideward, so that the eyeballs become slightly distorted in their endeavor to maintain a horizontal position. In these cases distinctness of form is sacrificed to luminosity and coloring. The colored minutiæ disappear, and are followed by a fusion of colors beautifully "soft." This is caused by the production of the image on the lateral portions of the retina.

ON BINOCULAR VISION.

The following is an abstract of a paper on binocular vision, read before the American Association, Providence, R. I., by Professor W. B. Rogers:—

Prof. Rogers began with the first principles on which the stereoscope is founded. If a bright bead be placed on an erect pin at one end of a board five feet long, and two black beads be set up in the same way near the middle of the board at such distance apart that when the face is at the other end, one black bead will hide the bright one from the right eye and the other from the left; on looking for the bright bead the eye will see three black beads. The middle or brightest one will be made up of the right bead, seen by the right eye, and the left bead seen by the left eye; the right hand image will be the right bead, seen by the left eye; and the other, the left bead, seen by the right eye. Now arrange a diaphragm, so that each eye shall see but one bead, and there will be but one image in the mind made up of two objects. This is the stereoscope. Every figure appears to be where the axes of vision intersect when they seem to see it. If the right eye sees only the left object, and *vice versâ*, the image will be seen nearer than the object, and larger; if, as usual, the right object be seen by the right eye, etc., the image will be more remote and larger. But one thing is curious: the eye must adjust its focus to the distance of the object, but in binocular vision the focus of the eye is not adapted to the place where the axes cross, but to the real distance of the objects. It does not always do this readily, and the effort necessary to make this adjustment is often the main difficulty in the use of the stereoscope. The lines that try the eye most are those that are to represent perpendicular lines at different distances from the eye. If you adjust the axes of the eye to the nearer wires of a bird-cage, those of the opposite side must appear double, and if you look at them the nearer ones will be doubled. In binocular vision this tries and

confuses the eye. Two lines not parallel may be combined in one, but then the plane of the combined image will no longer be perpendicular to the eye, but the ends that are nearer each other will appear nearest the eye. Figures that are unequal may be combined, as a triangle with a narrow base with another with a wide one, or even a straight line with the arc of a circle, but the resulting image is always thrown out of plane, and may even be warped. All these must be in a horizontal direction; two triangles of different *heights* can never be combined, nor can a horizontal line be combined with the arc of a circle. How is this combination effected? Brewster believes it is instantaneous; Wheatstone that the eye begins by adjusting one point on one line to the corresponding one of the other, and then another adjoining, and thus gradually forcing an image into the required plane. Brewster maintains that the eye can combine them by the light of an electric spark that lasts only a few millionths of a second. Professor Rogers doubted this, or thought it must at least be a rare case. Sometimes the eye gets fatigued in the operation; the lines remain open for a time, and at last return to the plane of the paper and remain uncombined. A high degree of approbation was elicited by this paper, which it is difficult to report fairly without copies of the figures and drawings of the apparatus used.

Professor Holton related an instance of combining two real objects into one image. He was lying in a berth of a steamship, with a Venetian blind within three inches of his face. The slats were horizontal, while his eyes were, of course, one above another. Two slats were combined in one, removed to twice the distance, and doubled in size, so perfectly that the sense of touch was not sufficient to destroy the illusion. He desired also to call the attention of the Section to the importance of raising the stereoscope from a philosophic toy to an important use in descriptive botany and zoology. Means may yet be found for taking photograph pictures of fresh orchid flowers, rare insects, etc., from which colored engravings may be prepared for the stereoscope, giving an idea of forms that could not be otherwise acquired but by models, without a journey to the tropics.

ON THE BINOCULAR VISION OF SURFACES OF DIFFERENT COLORS.

The following is an abstract of a paper read at the last meeting of the British Association by Sir David Brewster:—Professor Dove had published an account of some beautiful experiments in connection with this subject some years ago. M. Dove showed in his paper that when different colors at the same real distance are regarded by the eye they appear to be at different distances; this is also the case when a white surface is compared with a black. Now M. Dove argues if a white surface and a black one be stereoscopically combined, one of them must be seen through the other. Taking a figure for the left eye with a white ground, and a second figure of the same object on a black ground for the right eye, when these two figures are combined, a beautiful effect is observed: the figure starts into relief, and its sides appear to possess a shining metallic luster. This is the case when the surface of each

single object is quite dull and lusterless. On this experiment M. Dove founds a theory of luster, supposing it to be produced by the action of light received from surfaces at different distances from the eye. An example of this is the effect observed on looking at varnished pictures: one portion of the light comes from the anterior surface of the varnish, and the other from its posterior surface, the action of both of these conspiring to produce the observed luster. The metallic luster of mica is also referred to by M. Dove as an example of the same kind. In his present communication Sir David Brewster controverts the theory here laid down, and bases his objections on the following remarkable experiment: where a white surface without definite boundary and a black surface of the same kind are regarded through the stereoscope no luster is observed. Sir David therefore infers that the luster is due not to the rays from one surface passing through the other to the eye, but to the effort of the eyes to combine the two stereoscopic pictures.

STEREOSCOPIC DAGUERREOTYPES.

When two pictures, taken with two ordinary cameras, placed 2½ inches apart, are placed in the stereoscope, they do not exhibit that relief which is so striking in pictures taken in cameras placed further apart. Now as the human eyes are only separated by a distance of 2½ inches, the fact as above stated has excited much attention and inquiry, ending in controversy. Mr. Mascher, a well-known photographic artist of Philadelphia, is of the opinion that an explanation may be found in the fact that the lenses of the camera, are much larger than the eyes, and he infers that the distance separating the camera ought to be increased in porportion as their lenses are larger than the eyes. In the course of his experiments, he took a camera and reduced the opening by which light entered to a diameter of one eight of an inch, that being the diameter of the diaphragm of the human eye. He found that the focal range of the lens was thereby much increased. He then removed the lenses, and discovered that the pictures of external objects thrown upon the ground glass of the camera were very clear and distinct. Substituting a metal diaphragm with an opening one fiftieth of an inch in diameter for the picture diaphragm of one eighth of an inch in diameter, he obtained an excellent picture upon a prepared daguerreotype plate, without the intervention of a lens. His next proceeding was to make two apertures one sixty-sixth of an inch in diameter in the same camera, and the images were thrown on the same plate. After twenty minutes, exposure, good pictures were produced. These pictures possessed the proper amount of relief in the stereoscope, but being taken on the wrong side of each other for this purpose, it was necessary to cut the plate in two, and reverse their relative position.

PHOTOGRAPHIC TELESCOPE.

In accordance with a recommendation made to the British Association, by Sir John Herschel* in 1854, that daily photographic pictures be taken of the sun's disk, for the purpose of studying by comparison its physical features and changes,

* See Annual of Scientific Discovery for 1855, p. 203.

a photographic telescope has been ordered for the Kew Observatory. The proportions of the instrument, which is nearly completed, are as follows:—The diameter of the object-glass is 34 inches, and its focal length 50 inches; the image of the sun will be 0·465 inch, but the proposed eye-piece will, with a magnifying power of 25·8 times and focal length x, increase the image to 12 inches, the angle of the picture being about 13° 45′. The object-glass is under-corrected in such a manner as to produce the best practical coincidence of the chemical and visual foci. Other arrangements have been made with great care and accuracy for regulating the light, the time of producing the image, and for measuring the diameter of the spots, etc.

PRINTING ON CLOTH BY THE PHOTOGRAPHIC PROCESS.

The following method for printing designs on cloth by means of photography has been invented, and to some extent introduced in France. The cloth to be printed, or figured on, is first plunged into a chemical solution, and then dried in the dark: it thus becomes sensible to the action of the light. It is then exposed to the light, in the presence of the object to be reproduced, and when it has been submitted to the action of the solar rays, it is subjected to a solution which develops the colors and renders them permanent. This is the operation for fixing the colors, after which the material is washed. The printing machine is composed of a simple rectangular frame, mounted on four feet. The frame has on one side a flexible bar, and on this bar is rolled the cloth which is to be printed, properly prepared. From thence the cloth goes over the table and passes under a pane of glass, on which, by means of a combination of opaque or transparent objects, pieces of paper, for example, any design which is to be produced is figured. All the part of the cloth which is to be covered by the square remains under it the time necessary to subject it to the chemical action of the light, and it will be understood that this action is only exercised on those parts of the cloth which remain exposed to the solar rays. Those which are shaded are of course preserved. While this exposure lasts, the cloth remains in contact with the under side of the glass. This contact is procured in the following manner: The portion of the cloth exposed rests on a cushion composed of a pine board and several thicknesses of flannel, and two springs, one on each side, press the cushion against the glass.

As soon as the chemical action has been effected, which is discovered by the exposed surface becoming white or brown, according to the preparation which has been used, the workmen lower the cushion by aid of a lever, the cloth becomes free, and a new portion of it takes the place of the square of the one which was previously there, the first going on to be subjected to the fixing operation. For this purpose the last is carried by two rollers (*rouleaux de guides*) under the same table, where there is a trough containing the solution which is to develop the impression. The piece is drawn through by a couple of cylinders forming a roller, which are turned with a crank by a man, as soon as he has lowered the cushion which has just been mentioned. The setting the color is now done, and the cloth must be washed. This takes place immediately, the cylinders forming a roller, and depositing them in a tub filled with water.

The principal colors obtained by this wonderful process are red, yellow, purple, blue, white and green. To produce a pale blue design on a white ground, or white on a deep blue, they employ solutions of citrate or tartrate of iron, and ferrocyanide of potassium. The cloth is afterward plunged into a solution of sulphuric acid. Brown or chamois shades are obtained with a solution of bichromate of potash. The salt which impregnates the portions on which the light has not reacted, being removed by washing, these portions remain white, or are decomposed by salts of lead, to form a yellow chromate of that metal. By combining the two processes, and employing in addition madder, campeachy, etc., an infinite variety of shades may be obtained.

The exposure to the light varies from two to twenty minutes, according to the method employed, and the pattern used. Numerous experiments have shown that the light of a short winter day has all the power necessary—very beautiful specimens have been produced as late as four in the afternoon in the month of January.

IMPROVEMENTS IN PHOTOGRAPHY.

Photographic Impressions of Flowers.—Regnault, in a late sitting of the Academy at Paris, presented, in the name of A. Braun, of Dornoch, an album of actinic impressions of flowers, which were remarkable for their harmony and the chasteness of their model. Braun has proposed to form a collection of studies, intended for artists who use flowers as elements of decoration, whether in calico or wall-paper printing, or on porcelain, etc. He has attached groups of branches and flowers, so as to produce the most interesting effects in an artistic point of view. Those presented to the Academy, although a hundred in number, were only a small portion of what he had executed, all perfectly successful.—*Humphrey's Journal.*

Application of Photography to Porcelain.—M. Camarsac has recently published a plan for the "transformation of photographs into indelible pictures, colored and fixed." It appears to resemble the usual operations of painting on porcelain, though he also proposes to work on glass and enamel. The paper of the positive is consumed in the heat of a *muffle* (an enameler's oven), leaving the photograph on the porcelain, glass, or metal. These are colored with enamel colors, and burned in. He operates on white or colored bases. On the dark bases, the lights are formed by the reduced silver deposit, which obtains a great brilliancy from the fire. On porcelain, white enamel, and transparent glass, the blacks are formed by the metallic deposit, which he afterward treats with the salts of tin, the salts of gold, and of chrome. Another method he proposes, is to cover the porcelain, glass, or enamel, with a sensitive resin, and, by means of a negative, to print a positive thereon, on which he works with enamel colors, to supply the place of the sensitive varnish, which is to be destroyed by the heat of the muffle.—*Liverpool Photographic Journal.*

Lunar Photographs.—At a recent meeting of the Astronomical Society of London, Mr. Hartnup presented actinic maps of the moon, taken on collodion. The original impressions were one inch and a third in diameter, while those

presented were from 2 to $4\frac{1}{2}$ inches. For taking the impressions, the heliostat was regulated in such a manner as that the telescope gradually followed the moon's right ascension—the hour circle and the circle of declination having both been stopped, which maintained the moon as perfectly as possible in the same place as she appeared in the searcher, by means of the screw which gives the instrument its smooth motion in right ascension and declination; the telescope being 4 feet diameter. Two of the images taken, one before the other, from the full moon, when combined together in the stereoscope, gave a sensation of well-detached relief; we may say a semi-globe, with the half transparent. The enlarged views have been projected on a screen by the magic-lantern, and are much admired.—*Humphrey's Daguerrean Journal.*

Colored Photographs obtained by simple exposure to light.—At a recent meeting of the *Société de Photographie*, Paris, M. Beauregard exhibited a number of colored photographs, of which the following description was given. The prints form a series of colored images, some uniformly blue, yellow, or rose; others possessing the different tints, in relation to natural colors upon the same sheet of paper. Among the latter, one represented the head of a woman draped with a transparent vail, and bearing a basket of foliage. The flesh is of the natural color, the vail violet, and the foliage green. Another is a portrait of a woman, whose face and hands are flesh-colored, the eyes blue, the hair light-brown, the dress green, and the collar and sleeves white. Lastly, a portrait of a child, which, besides the flesh-color of the face, hands, and legs, presents a dress striped with green and yellow, black boots, white linen, and a couch of black wood with chamois cushion. There is also a little landscape, with the effect of sunset, tinted with different colors.

M. de Beauregard set out from the long-known fact that there exist salts which are colored in a different manner by light; that this diversity of coloration is manifested not only in relation to the special nature of each of the salts, but also from the same salt, in proportion to the duration of the action of light; or, in other words, to its intensity. This point being settled, M. de Beauregard asked whether, by combining several of these salts, either directly in the same bath, or on the paper itself, by means of successive immersions in baths of different compositions (such, for example, as photographers at present use for producing iodide of silver), it would be possible to obtain papers which, when exposed at once to the action of light, would manifest the different colors, and these more or less deep in tint, according to the nature of the salts and the intensities of the luminous rays.

It is important to state here that the process of M. de Beauregard does not consist in applying colors locally, as in the printing or dyeing of stuffs. The colors which he obtains are produced in the printing-frame itself, by one and the same impression of light, except merely the fixation and final development of the print, as with the hyposulphite baths in the ordinary process. The first idea of M. de Beauregard was simply to study the means of producing photographic prints at a low price, and for this purpose he set to work to find a substitute for the salts of silver. He first tried ferro-cyanide of potassium. This salt it is which, in moderately concentrated aqueous solution, gives the print that uniform blue tint which we see in the various specimens exhib-

ited. It gives a very rich scale of tints, from the lightest to the deepest, according to the duration of the exposure to the light. The paper is prepared by placing it for a few minutes on the surface of the bath and immediately drying it. When sufficiently impressed by the light, through the negative which it is desired to print, the image is fixed by the immersion for some time in pure water. At this moment the print has not attained its perfection; by immersing it in a strongish solution of alum, the color is heightened in a remarkable manner. M. de Beauregard obtained the yellow color by impregnating the paper with a solution of bichromate of potash, and a prolonged exposure to light causes this color to change to green. He fixes the print by washing in common water and then by immersion in a solution of alum. The bichromate of potash may also be usefully employed for giving black tints, which may be carried to a very great intensity, without any salt of silver; a most important result in regard to economy in the production of positives. The mode of treatment is this:—After removing from the frame the print obtained on paper impregnated with the bichromate of potash, it is immersed for a few minutes in pure water. Then it is passed through a solution of protosulphate of iron. The paper is washed again, and then loses all trace of the picture. But on plunging the paper into a bath of gallic acid, the print is developed, and assumes a blue-black color, the intensity of which may be increased by using an infusion of logwood. One of the most interesting points of the process of M. de Beauregard, and that which has most strongly excited attention, is the different coloring upon the prints. The process by which he obtained these various colors, which he has succeeded in producing on the same paper by a single exposure to the light in the printing-frame, consists in impregnating the paper with two mixtures successively, taking care to dry the paper after the employment of each mixture. The first mixture is formed by a solution of permanganate of potash with the addition of tincture of turnsol. The second mixture is formed of ferro-cyanide of potassium acidulated with sulphuric acid. The paper thus prepared must lastly be subjected to a bath of nitrate of silver. After the impression has been obtained, the paper is first washed in pure water, then immersed in a weak bath of hyposulphite of soda; finally after a fresh washing, the colors are brought out vividly in a bath of neutral gallate of ammonia.

It remains to give an explanation of the phenomena presenting themselves in the production of these prints. They are referable to a physical and chemical reaction produced by solar light on the different bodies and salts above indicated and employed for the first time in photography. M. Beauregard advances a theory in reference to this discovery, which is, that the different luminous rays impress the collodionized glasses in a manner precisely similar to that which is necessary for the exact reproduction of the natural colors; so that the negative well brought out by light, possesses in itself, and by the effect of the radiations of the different rays of the spectrum, the relative and proportionate intensities proper to develop, on the positive paper prepared by his process, the natural colors of the model.

If this theory should prove true, the problem of obtaining color directly by the agency of light would be solved.—*Jour. Phot. Soc. London.*

Improvement in the Collodion Process.—The great difficulty with this most sensitive process has been the rapid loss of sensibility after the plate has been properly excited. This has arisen from the rapidity with which the ether and alcohol of the collodion are removed by evaporation. Messrs. Spiller & Crookes of London, have adopted the following method, which seems to overcome the difficulty in question: After the collodion plate has been fully prepared in the usual manner, it is placed in a bath of nitrate of zinc containing a small quantity of nitrate of silver. In a few minutes it absorbs a sufficient quantity of this salt to secure a long-continued moisture on the surface; and thus plates which have been prepared for five days have retained a sensibility equal to that which they possess, under ordinary circumstances, for five minutes.

Photography and Wood Engraving.—Mr. R. Langton, wood-engraver and draughtsman, of Manchester, has produced some very successful and beautiful specimens of photography, taken by himself, on blocks of box-wood. This photograph, so taken, is quite ready for the application of the wood-engraver's burin. It is impossible to say how greatly this will advance the process of wood-engraving, especially by saving all the preliminary labor of the draughtsman; which, in many cases, constitutes the chief element in both the time and the cost attendant on the production of wood-engravings of a high class. Even in many of the lower branches of the art, the new application of sun-drawing will be an invaluable auxiliary. For instance, it is an exceedingly difficult matter to get accurate drawings of machinery in perspective; mechanical draughtsmen only represent it in plane; and artists are generally found extremely reluctant to employ a large amount of time so unprofitably as the drawing of a complicated machine in perspective demands. These photographs can now, in a few seconds, accomplish what it would require hours for the artist to effect, and in point of accuracy the instrument must ever have the preference. But great as will eventually be the boon which this new application of photography will confer on the practical art of wood-engraving, it may be made more extensively valuable as a cheap form of producing pictorial objects. By Mr. Langton's process, portraits, landscapes, etc., could be produced on any smooth piece of wood, duly prepared; and thus even wooden snuff-boxes, hand-screens, etc., may be decorated with portraits, or scenes from nature, or copies of works of art, at a cost much less than daguerreotypes on metal plates. Indeed, it is difficult to say where the application and uses of this new process may extend. The inventor does not limit his invention to its use in wood-engraving, but claims for it an equally valuable application in other directions, in connection with practical art.—*Civil Engineer and Architect's Journal.*

Duration of Photographs.—What is the average duration of a photograph or daguerreotype? Is their longevity in a ratio with the period of time of their production, or is their existence's length determined by other elements? In these matters, time is the only possible Œdipus. But some photographs last longer than others, and some have already faded away from the sensitive plate. It seems, however, these may be recalled (according to MM. Davanne and Girard) by a salt of gold, but with different aspects and shades, which go from red to black and blue; there being a complex reaction, viz., a pre-

cipitation of metallic gold, and the formation of a chloride of silver. The cause of the non-durability of photographs is suggested as due to the use of the hydro-sulphate of soda; and ammonia has been suggested as better for use, instead of the former.

This phenomenon has also attracted attention during the past year in England; and in London a committee of scientific photographists has been constituted, and a fund raised for inquiring into and reporting on the subject.

The number of applications of the photographic art to the practical operations of every-day life, is rapidly increasing. An extensive coach-building establishment in England has recently adopted the practice of having a photographic picture taken of every carriage finished. A picture in accurate perspective is thus obtained, with every detail fully wrought out, in a manner that would defy the highest powers of the best skilled artists. The customers, also, of the establishment, who generally can make nothing out of plain, geometrical side elevations and working drawings, are enabled to judge of the actual effect of an equipage, before committing themselves to an order for it. The camera also greatly assists the private operations of the coach-builder, for, after finishing any complicated or uncommon kind of carriage, he can in this way obtain a perfect representation of it, in all its parts and proportions; so that he can build an exactly similar one at any subsequent time—perhaps after the lapse of many years, when the details might otherwise have been forgotten.

It is also obvious that this plan might with the same advantage be applied to many other forms of construction as well as carriages.

The introduction of photographic views as evidence in the case of suits and trials at law, for the purpose of explaining the position of buildings, utensils, nuisances, locations, etc., has been extensively resorted to in England.

Photography has been used successfully at Paris in taking views of clouds; they have been obtained by Bertsch in hardly a quarter of a second, in a style that leaves nothing to be desired. These pictures are adapted to resolve all important questions relative to their form, distribution, and height. M. Pouillet measures the height by means of two photographic apparatuses placed at a distance from one another.

Another interesting use which has been made of the photographic art, has been the delineation and reproduction of the scenes and localities of the Crimean war. The London *Athenæum* in noticing the wonderful accuracy and life-like appearance of a published portfolio of these pictures, thus remarks:—"For the first time since men fought we shall have history illustrated by the certainty of a reporter who never blunders, never errs. Men will fall before the battle-scythe of war, but not before this infallible sketcher has caught their lineaments and given them an anonymous immortality more lasting, perhaps, than 'storied urn or animated bust.' As photographists grow stronger in nerve and cooler of head, we shall have not merely the bivouac and the foraging party, but the battle itself painted; and while the fate of nations is in the balance we shall hear of the chemist measuring out his acids and rubbing his glasses to a polish. We shall then have indisputable tests for promotion; and may, perhaps, form galleries of national victories

more simple but more veracious than the poor melodramas of Versailles or the Louvre. Then, every Englishman's portfolio will be a hero's Westminster Abbey; and a richer reward than star or ribbon will be conferred on the leader, whose monument would be forever before the eyes of his grateful country.

Photographic Impressions of Blood-Globules.—Photographic views of blood-globules taken by M. Duboscq, of Paris, have lately formed the subject of a microscopic exhibition at the Royal Polytechnic Institution. The globules of the blood of the human race, of animals, of birds, reptiles, and fishes, were shown upon the white curtain. The specimens all exhibited the same general features, varying only in size and shape. The subject is highly important, not only in a medical, but a judicial, point of view, for all blood-stains could thus be analyzed and be made to assist in eliciting the truth, while, for medical purposes, every disturbance that affects the human economy could thus be scrutinized and remedies suggested according to the appearances indicated.

ON A PROCESS OF OBTAINING LITHOGRAPHS BY THE PHOTOGRAPHIC PROCESS.

Professor Ramsay at the British Association, Glasgow, described a process by which Mr. Robert M'Pherson, of Rome, had succeeded in obtaining beautiful photo-lithographs. The steps of the process are as follows:—1. Bitumen is dissolved in sulphuric acid, and the solution is poured on an ordinary lithographic stone. The ether quickly evaporates, and leaves a thin coating of bitumen spread uniformly over the stone. This coating is sensitive to light—a discovery made originally by Mr. Niepce, of Chalons 2. A negative n glass, or waxed paper, is applied to the sensitive coating of bitumen, and exposed to the full rays of the sun for a period longer or shorter according to the intensity of the light, and a faint impression on the bitumen is thus obtained. 3. The stone is now placed in a bath of sulphuric ether, which almost instantaneously dissolves the bitumen which has not been acted upon by light, leaving a delicate picture on the stone, composed of bitumen on which the light has fallen. 4. The stone, after being carefully washed, may be at once placed in the hands of the lithographer, who is to treat it in the ordinary manner with gum and acid, after which proofs may be thrown off by the usual process.—Professor Ramsay then proceeded to state that the above process, modified, had been employed with success to etch plates of steel or copper, without the use of the burin:—1. The metal plate is prepared with a coating of bitumen, precisely in the manner noticed above. 2. A positive picture on glass or paper is then applied to the bitumen, and an impression is obtained by exposure to light. 3. The plate is placed in a bath of ether, and the bitumen not acted upon by light is dissolved out. A beautiful negative remains on the plate. 4. The plate is now to be plunged into a galvano-plastic bath, and gilded. The gold adheres to the bare metal that refuses to attach itself to the bitumen. 5. The bitumen is now removed entirely by the action of spirits and gentle heat. The lines of the negative picture are now represented in bare steel or copper, the rest of the plate being covered by a

coating of gold. 6. Nitric acid is now applied, as in the common etching process. The acid attacks the lines of the picture formed by the bare metal, but will not bite into the gilded surface. A perfect etching is thus obtained.

THE AMBROTYPE.

This term has been applied to the result of a new process, recently patented by James A. Cutting, of Boston, which consists in taking pictures photographically on a film of collodion, on the surface of a sheet of glass, the collodion being suitably prepared for the purpose. The nature of the process will be easily perceived by the following abstract of the specification accompanying the patent:

It has been found that when gun-cotton has been exposed to the action of the atmosphere for the purpose of drying it, the sensitiveness of the collodion prepared from it is sensibly diminished. By the use of alcohol it may be deprived of its moisture after being washed, without exposure to the air, and without the constant deterioration of its sensitiveness. This part of my process I conduct as follows: So soon as the cotton has been sufficiently exposed to the acids, and has been thoroughly washed, it is plunged into strong alcohol, which effectually deprives it of the water which it contains, without exposing it to the atmosphere for the purpose. From this alcohol it is taken immediately to the mixture in which it is to be dissolved for the purpose of forming the collodion. This mixture consists of 10 parts of sulphuric ether and 6 of alcohol, or thereabouts. The collodion thus formed is allowed to remain until it has settled perfectly clear, which usually requires about 24 hours. It is then decanted, and in every pint is added 80 grains of iodide of potassium dissolved in alcohol. It is then well shaken, and 32 grains of refined gum-camphor is added to each pint of the collodion, and after it is again settled it is fit for use. The object of the camphor is to increase the vigor and distinctiveness of delineation of the positive pictures, and particularly of the half tints. It also greatly increases the beauty of the picture, by giving a fineness of deposit not heretofore attained by any other means. The use of the gum-camphor in the manner above described forms the second branch of my invention. The collodion is then applied to the surface of the glass in the following manner:

The plate of glass being held horizontally, a portion of the collodion is poured upon it, and it is then inclined in different directions, so as to cause the collodion to flow over its whole surface, upon which it forms a colorless transparent film; the excess of collodion is then allowed to run off, and the glass, being still held horizontally, is inclined to one side and the other, until the collodion becomes partially thickened or set. When this has taken place, and before it is dry, it is rinsed in a solution of crystallized nitrate of silver, of a strength of 40 grains to the ounce of water; the film is thus impregnated with iodide of silver, and after remaining in this bath a sufficient length of time for the ether to escape from the collodion, the plate is ready to be placed in the camera. After being exposed a sufficient length of time in the camera, it is taken to a dark room, where the latent picture is developed by the appli-

cation of a solution of protosulphite of iron, acetic acid, and nitric acid, in about the following proportions: 1 quart of soft water, 1 ounce protosulphite of iron, 32 drachms No. 8 acetic acid, 1 drachm nitric acid. These exact proportions are not rigid, but I have found them to be sufficient for the purpose of developing the picture. After this is accomplished, it is washed in clean soft water, and then the remaining iodide of silver is dissolved from the collodion film by a solution of hyposulphite of soda, after which the picture is entirely cleansed by the hyposulphite solution by washing as before in soft water. The picture is then dried, either in the open air, or by the aid of a gentle heat, and the process is completed.

To permanently improve the beauty of the pictures, and to deprive them of a bluish, hazy, and indistinct look, is the object of my third improvement; which consists in the application of a coating of balsam of fir to the surface of the glass upon which the picture is made, the balsam being confined to the picture-plate by a secondary plate or glass, which is applied to the picture-plate in a manner which will now be described, and which hermetically seals up the picture and protects it from every and any injury not sufficient to fracture the glasses themselves. This part of the process will now be described:

A second plate of glass is prepared, of the same size as that which carries the picture, and is thoroughly cleansed; the picture-plate is then held horizontally, the picture-side uppermost. The balsam is then applied in a line along one edge of the glass, and one edge of the secondary plate is then applied to the edge of the first which contains the balsam. The two plates are then pressed gradually together, by which the balsam is caused to flow entirely across the picture toward the opposite edge, and the air is effectually excluded from between the plates. The superabundant balsam is then removed by pressing the glasses together, and a thin coating of it only is left upon the surface of the picture. The beauty and distinctness of the pictures are greatly enhanced by this application, the finer lines as well as the dark portions and shadows being rendered far more distinct, and the most minute delineations being brought out and made visible, while the application of the second plate of glass secures the whole from the action of air, moisture, and dust.

ENGRAVING FROM DAGUERREOTYPES.

From the Report of the U. S. Coast Survey for 1854, by Professor Bache, we derive the following information respecting some most interesting and important experiments made under the direction of the Department by Mr. George Mathiot, for obtaining directly, by chemical means, from drawings, engraved plates for printing. The particulars of the experiments are embraced in the following extract from the report made by Mr. Mathiot to the Superintendent. Mr. Mathiot says, "During the past summer I have made a number of experiments on the natural-engraving processes proposed by Donné, Grove, Gaudin, Talbot, and Niépce, with a view of obtaining by chemical means, and directly from the original drawings of the survey, copper-plates ready for printing maps, without the long and tedious process of the mechanical artist. So far, I have not *determined* that I shall obtain a chemiglyphic process; yet I have been

much encouraged by my experiments, and have strong hopes of being able to substitute this process for a considerable portion of the engraving, if not to make a complete map. My examination has not yet extended to the processes of Niépce and Talbot, except that I have determined that their processes can be worked on copper, which is much more economical than steel, as the plates of copper can be prepared by the electrotype process of perfect surface, while expensive manual labor only can furnish those of steel.

"M. Donné proposed to etch a Daguerreotype with nitric acid. The chemical difference between the 'lights' and 'shades' of the Daguerreotype appears to be sufficient to determine the action of the acid to the dark parts, which are supposed to be silver, while the lights are mercury. I found this process extremely uncertain. In twenty carefully-conducted experiments, I succeeded but once in getting definite markings, and this only on a portion of the plate experimented on: hence, I conclude the process is not likely ever to be turned to account. Professor Grove proposed to engrave the Daguerreotype plate by electro-etching it, making it the positive electrode in a strong bath of chlorohydric acid. This process gives engraving of great beauty, but, unfortunately, of very great delicacy. I made over a hundred trials of this process, and, although I generally obtained a beautiful engraving, yet in only two instances did I obtain lines of sufficient depth to print from, and then the quantity of ink which could be held in the line was only sufficient to give a mere stain on the paper, instead of a well-defined black line. M. Gaudin proposed to conduct the process of M. Donné on a plate of steel, covered with a film of silver, to enable it to receive the Daguerrean image. This was designed for producing the graving on a more durable material than silver. But M. Gaudin does not state whether he designed merely to communicate a silver character to the surface of the steel, to enable it to be used as a Daguerrean plate; or whether he designed such a coating, that while it might be eaten through in the shades, to expose the easily-oxidable steel, the lights would be protected by the silver film. If the former were his design, I must conclude, from my experiments, that it is impossible, because an infinitely thin coating of noble metal over an oxidable one, determines the formation of multitudes of small galvanic circles on the surface.

"I have long had the idea of silvering a copper plate just sufficiently thick to defend the copper from such chemical action as would corrode it, and of then eating through this film by the process of Professor Grove, and afterward well biting the copper in the bared parts. This I have great expectation of determining to be a practicable method of producing a chemiglyphic line-engraving; but the essential idea of this is probably due to M. Gaudin, instead of myself.

"The thickness of the film of silver required for the protection of the base metal I have found to be quite considerable; and this, combined with the very slight depth to which the silver can be etched, makes the problem of obtaining an engraved plate by the method I propose, one of great delicacy. Unfortunately, the requisite thickness of the film is nearly equal to the greatest depth of bite that can be obtained; and hence we may have a good Grove's etching on the film, yet the base metal only partially denuded; and then, if we at-

tempt to enter the lines into the base metal, the result will be extremely irregular and partial. Again, if the film of silver is not quite sufficient in thickness, the lights of the Daguerreotype will be attacked, and the shades blurred by the spread of the lines. The problem depends, therefore, on getting a good protecting film, and then a good biting *through* this film. If the thickness of the film was not, unfortunately, so nearly equal to the depth to which the silver can be etched, I think the making of an engraved plate by chemical means would be comparatively easy.

"A copper plate should have the surface prepared very perfectly. It is then to be electro-plated to the weight of one eighth of a grain to the square inch; but this thickness is not yet well determined. The plate, after being washed in distilled water and dried, is to be slightly buffed, and the Daguerreotype taken in the usual manner. Professor Grove recommended chlorohydric acid as the electrolyte for etching; but, in acting on a plate of base metal merely enfilmed with the silver, we evidently should select an electrolyte which will not be liable to act on the base metal. Of the various electrolytes I tried, I found chloride of sodium the best: this seems to free the generated chloride of silver more readily than clorohydric acid, is without much action on the copper base, and has the very great advantage of being free from poisonous qualities or disagreeable exhalations.

"The object of the biting process, so far, has been only to remove the silver from the parts where we want the copper to be bitten in deep lines; but this process evidently can not be continued till the copper has been bitten sufficiently deep, for it acts on the silver as well as the copper; hence, the first biting should be continued only long enough to work through the silver film; here there is a liability of spoiling the work in the beginning, by overdoing the first biting, which will infallibly remove the silver from the lights in some places, and give the whole plate a blurred or mezzotinted appearance. I can give no directions for the time of the biting through the film; practice and dexterous manipulation, as in the Daguerreotype process, are the only helps here. After the plate has been bitten through the film, it should be washed by immersing in water, and dried over a current of heated air. If, on examination, there appear no marked defects, the process of entering the lines into the copper may be gone on with. For this purpose I have used perchloride of iron, persulphate of iron, and also nitrate of silver. I have not determined which of these is the best; but, so far, I have a preference for the perchloride of iron. The perchloride may be added to water till it has a lemon-yellow color. The plate is to be immersed in a horizontal position, with the face up in the solvent, and a soft camel's-hair pencil swept gently over it from time to time. In the course of thirty minutes, or less, the action of the perchloride will have thrown up the chloride of silver, so that the brush can sweep it away, and the bright copper will appear in the bottoms of the lines. The plate may then be washed and dried, and if, on inspection, it should not be thought deep enough to hold the ink for printing, it may be returned to the bath of perchloride for a short time. I have not yet obtained a plate which has not been much corroded in the lights; and this corroding in the light has caused me to discontinue the second biting, before the depths of the lines has

been sufficient to hold the full quantity of ink required to give a clear black print. When nitrate of silver is used for the second biting, the tendency to open the pores of the film is not so great as when the iron salts are used; but this solvent has a very great tendency to deposit the reduced silver in the fine lines, and this even closes the pores of the film; but, for coarse lines, I have thought that it made a cleaner plate than the iron salts. I have sought to obtain a third biting, by filling the lines obtained by the second biting with some non-conducting substance, and then heavily silvering or gilding the lights, dissolving out the non-conducting substance from the lines, and again biting; but every experiment I have made in this direction has failed for the following reasons:—the only salts of silver and gold which can be successfully used for electro-deposition are alkaline; the alkali, acting on the oil, gum, resin, wax, or other hydro-carbon which fills the line, dissolves it before the lights are sufficiently coated. Again, when the non-conducting film in the lines is very thin, it is ruptured by the affinity which the negative element of the electrolyte has for the copper. I find that asphaltum is not very readily acted on by the alkaline salts of the noble metals, but I have not yet succeeded in working this substance into the lines.

"I took an alto by the electrotype process, from a plate, after the first biting, and gave the alto a good coat of gold, and ground down the raised lines with a soft piece of charcoal, so as to cut through the gilding and expose the copper. The plate was then bitten with the perchloride of iron: all the fine lines, as the hair-strokes of the letters and figures, were destroyed, but a good solid cutting of the coarser parts was obtained. In putting on the silver, I judged of the thickness and weight by making the current which reduced the silver pass through a voltameter in the same circuit, and carefully noting the volume of hydrogen evolved, and referring to the respective equivalents and specific gravities. This is a rather laborious process, but it is probably the only one by which small quantities of electro-deposited metal can be measured.

Some of the trial maps for the Coast Survey printed from Mr. Mathiot's plates are perfect in detail, yet deficient in vigor, which is the only thing required to make them engravings of the very first order. As it is, some of the plates, executed in the short space of eighteen minutes, from drawings on paper, are, with a slight retouching by the graver, sufficiently perfect for use; thus producing an immense saving in time, labor, and expense. Mr. Mathiot is still prosecuting his experiments under the direction of the Coast Survey Office, and further interesting results may be expected.—*Editor.*

Some fears having been expressed by the editor of *Humphrey's Photographic Journal* in regard to this process, "that the action of the acid in biting in the copper in the barred parts, would also proceed laterally as well as deeply; and thereby breaking up the superficial coating, whether of silver or gold, and producing rough and uneven lines," Mr. Mathiot, in a reply, published in the Journal, Nov. 15th, 1855, says: "These objections are indeed formidable. I believe these difficulties have confronted every one who has thought of actino-engraving, and have hitherto been considered as insurmountable, in their very nature. They also attend the common etching processes of the engravers; here, too, it is found that the fine lines become un-

dercut in an irregular manner, and blended together, and the broad lines are smooth on the bottom.

"But all these difficulties were duly considered in the Coast Survey Office, in the very beginning, and had there not appeared at least a *prospect* of overcoming them, the announcement had never been made that we were endeavoring to apply actino-engraving to facilitate the production of our charts. The difficulty has not, indeed, been wholly overcome; for then the whole problem of actino-engraving were completed; yet it has been greatly reduced, and what remains of it does not appear of such magnitude but that it may be overlooked, at least in the production of the coarser kinds of engraving.

"First of all, it has been found that the great irregularity, undercutting, and spreading of the lines in the common etching process, are due to the peculiar nature of the solvent (nitric acid) employed, and the irregular texture of the metal; which irregularity causes one part to serve in an electrical relation to another; thus thousands of points and lines of action are formed, other than those of the design. Again, nitric acid is an electrolyte, just the thing to concur with the irregular texture for the production of irregular action; and the nitric acid, in acting on the metal, is decomposed into several substances, which have various actions on the metal. If a clean line is once begun, why should not the solvent act on it uniformly on all the parts? If it does not, there are reasons for it, and those reasons I have given you above. I indeed am aware that 'to find the cause of a disease is not to find the cure,' but still it is to find where the cure is to be applied.

"In the Daguerreotype, the mercury is determined to those portions of the plate where the light has acted, producing a drawing in mercury on a silver ground. The chemical difference between mercury and silver, with respect to nitric or hydrochloric acid, has been the fundamental idea in all the previous attempts to engrave the Daguerreotype; the mercury being noble to silver, it was supposed that it would serve the part of the common etching ground, to limit the action of the acid. But the chemical difference between silver and mercury is not at all sufficient for this purpose. Silver forms but an extremely feeble voltaic combination with mercury; and the two metals behave very nearly alike with nitric or hydrochloric acid. I have now determined, in the most indisputable manner, that the formation of the etching is not at all owing to the mercury acting as a protecting film. Let a strong Daguerreotype be made, and finished in the usual method, except the gilding; then let the design be rubbed out, and the plate well buffed and *galvanized:* Now let the plate be connected with the battery for etching, after the manner proposed by Professor Grove, and, lo! the design will appear by being etched. Where now is the protecting film of mercury? Any mode of etching founded on such an idea is but a chimera, and must necessarily fail.

"I have come to the conclusion that the Daguerrean image is molecular, and not chemical, in its production and constitution. What do you think of a picture all the way *through* the plate, and the plate wholly formed of pure copper? I can easily produce such now. In the lights of the picture the silver is cristallized, and the cristallization is proportional to the intensity and duration of the light. The action of the light on the halogenized sur-

face, is either to produce an incipient crystallization of the silver, which is afterward continued by the mercury, or else it in some way promotes the susceptibility to being crystallized by the mercury. It is well known that the action of mercury in small quantities on a metal is to crystallize it. In some of the metals its action is so energetic that the mass is severed by the new arrangement of the metal. That it is the crystallization which determines the action of the solvents to the design, will appear from the well-known fact that crystallization resists the action of solvents, and also that the plate is bitten all over; most in the deepest shades—least in the brightest lights. If the mercury acted as a protecting film, the action would spread under the lights and cut-lines, wider at the bottom than at the top, and leave the lights smooth and flat, and terminating abruptly. But any person who will take the trouble to etch a Daguerreotype, will soon perceive that the edges of the lights are rounded off, and the lines are wider at the top than in the bottom. The crystallization in the Daguerreotype goes down deep into the metal; it also extends itself under the shades, or laterally, from where the mercury has deposited. Now, the consequence of this spreading of the crystallization under the shades is, that the lines [whites?] of the etching are, in the beginning, somewhat narrower than in the Daguerreotype or in the drawing. Here is a provision against the spread of the lines, in deepening into the copper.

"With the smoothness of the bottom of the wide lines I shall not trouble myself yet awhile. The electrotype process must necessarily be employed for forming the plates; by no other means can metal of absolutely uniform texture be made. But the electrotype gives us the means of entering a plate at any desirable part, and altering its contexture; and this is giving us the means of making the solvent bite what is called a "grain" at any desirable depth from the surface. Suppose, after the plate has been formed to the thickness of an hundredth of an inch, it be taken from the electrotype apparatus and dusted over with powder of silver, and then returned to the apparatus and completed in thickness, would not the solvent, in biting down from the face of such a plate be resisted by the particles of silver, and thus form a very rugged surface?"

NEW PROCESS FOR ENGRAVING ON ZINC.

M. Dumont, an engraver of Paris, describes, under the name of *Zincography*, a process for electric engraving, which is promising. Upon a thick plate of zinc, planed and grained with a steel tool and fine sand, he draws any subject with a kind of lithographic crayon; upon the design, when finished, he sprinkles a fine powder, mixed with resin, Burgundy pitch, and bitumen of Judea; by heating the zinc plate he melts this powder, which is converted into a varnish, and spreads over the parts of the surface which have been covered with fat crayon, that is, on every thing which constitutes the design. To bite in the plate, and obtain the design in relief, he plunges it, while in connection with the positive pole of the pile, into a bath of sulphate of zinc, in face of another plate connected with the negative pole; the current passes and cor-

rodes the zinc which is not covered by the ink, and thus the design is brought out; from the plate thus engraved in relief, a gutta percha mold is taken, in which copper is deposited to obtain the engraved plate, from which proofs may be taken by the ordinary typographic press.

OBSERVATIONS ON THE MEANS OF INCREASING THE QUANTITY OF HEAT DERIVED FROM COMBUSTION.

The following is an abstract of a paper presented to the American Association, by Professor Henry, at the Providence meeting:—Rumford noticed the fact that a mixture of clay with sea coal caused more heat to be evolved than he was able to produce with coal alone. He found that when the sides and back of a chimney are lined with fire-brick, they give out more heat than the coal itself. Rumford also suggested that the bottom of the fire grate be covered with balls of clay, in order that a greater radiation of heat may take place. He gives, however, no account of experiments definitely made, or of the cause of the phenomena he witnessed. In reading the account of his experiments, his results appear at first sight paradoxical: but Rumford was an eminent experimenter, and the facts he has stated in connection with various branches of physical science are found to be supported as science advances.

After expounding Rumford's plan, Professor Henry said the idea had occurred to him to repeat the count's experiments, or to make further researches with the aid of such appliances as modern science furnishes. These investigations had been prosecuted for a number of years. His method of operating was as follows:—He took a thermo-electric apparatus, applied a tube at the end of the instrument so as to circumscribe the field of radiation, and placed it near a coal fire. The idea was to see if fire could be made hotter. And it was. The result confirmed the assertions of Rumford. A coal fire, however, was difficult to manage; the coal was anthracite, and not bituminous: the latter was probably employed by Rumford. The experiment was repeated with ordinary flame—with the flame of hydrogen and that produced by the combustion of alcohol, placed at such a distance that the needle of a galvanometer stood at 15°. A platinum wire, coiled, was inserted in the flame, when the radiation increased, and the galvanometer marked 27°. Subsequent experiments were made with carbonate of lime, sulphate of lime, stone coal, fire clay, etc. These substances were introduced into flame and the degree of radiation marked. Different substances produced different effects; the greatest effect being produced by *carbonate of lime.* Precise results were not ascertained. We could not suppose that the absolute amount of heat was increased. The most probable conjecture Professor Henry thought was, that the heat of combination was converted into radiant heat. To test this he had placed a platinum wire in the apex of a flame and introduced a slip of mica, one-fifth of an inch in breadth, vertically beneath it. The wire immediately diminished in intensity of light and of radiant heat, so that while the mica itself was radiant with light and heat, it was evident that its introduction cooled the flame above it, verifying the idea that the intensity of radiation was produced at the expense of the heat of combination. So if fuel was to be employed in

the evaporation of water by combustion under a kettle, its effect would be diminished by any substance intervening between the flame and the kettle, and the flame ought to be made to strike directly on the kettle with considerable force. But a very different fire was required to warm a room. In that case, radiating substances might be employed to advantage.

ON THE DEGREES AND ZERO OF THE THERMOMETER.

The following communication was presented to the American Association by Professor J. F. Holton:

The thermometer is not, as its name would indicate, a measure of heat. It merely shows that one temperature is the same as another, or higher, or lower, but it does not measure the difference between them. The thermometer shows, for instance, the temperature that we name 40°, 50°, 60°, but it does not follow that the difference between 40° and 50° is the same as that between 50° and 60°. Indeed, it is not proved that these distances are commensurable quantities at all, or that the one is either equal to the other, greater, or less. It may be as impossible to assert such equality or inequality as to say that a pound is equal to an hour, or greater, or less. To make this clear let us propose to divide the difference between the boiling and freezing point into two equal parts. We may attempt to fix the middle point by mixing a pound of water at 212° with a pound at 32°; or we may take a pint of each with a different result. If we substitute some other substance for water we have every time a new result. If we abandon mixtures and resort to expansions we succeed no better. Take for the most satisfactory of these the expansion of the perfect gases. The rule is commonly stated that 448 volumes of gas at 0 Fahrenheit increase one volume for each degree. It would follow that 480 volumes at 32° becomes 570° at 122°, and 660° at 212°. In other words, 100 volumes at 32° become, by an increase of 90°, 118·75, while 90° from 122 to 212 increase 100 volumes only to 115·79. Thus causes which we assume to be equal produce unequal effects. But the assumed law of expansion of gases may itself be called in question. For if 480 volumes at 32° lose one volume with each degree of temperature, at 447° they will be reduced to a single volume, and at 448° annihilated. But if we admit the law for temperature above 32°, and would so modify it that each increase of 1° of temperature shall convert 100,000 volumes into 100,208, then must the divisions on the scales, both of the air thermometer and also of the mercurial, be made logarithmic and progressively larger as the temperature increases. This would add to the difficulty of graduation without any compensating advantage. If equality can be predicated of increments of heat it must presuppose an ascertainable absolute zero, just as equal gradations on a hygrometer, were there such an instrument, would be based on an absolute dryness of a gas. I will not speculate on the possibility of ever measuring the absolute heat in any temperature. I have designed only to show that all the points on all our thermometric scales are arbitrary, like those of Wedgewood's pyrometer, and all that we can do is to select such as can be best ascertained and repeated in successive instruments. The safest and most ready of these is by using the

difference of expansion between mercury and glass. A boiling point and a freezing point being duly established, the space between them should be divided into equal parts, and the points between them constitute permanent landmarks for the indication, not the measure, of temperature.

Two points are still open to discussion: the size of the degrees, and the zero. The size of the degrees should not be larger than the least now in use. It would be better for the purpose of graduation that the number between boiling and freezing were 256, or some other power of 2; but the mechanical difficulty and the necessity for exactness are not so great as to demand a change from 180, which makes them so small that we never divide them, except in mean temperatures. Those of the Centigrade, and still more those of Reaumer, are seriously objectionable, as observations ought generally to be recorded in fractions. As to the zero, it should not be higher than the lowest in use, as even that requires negative signs in observations on the air in high latitudes. It is a pity that a zero were not taken near the freezing point of mercury, or even below the supposed temperature of the planetary space; but the number of observers in high latitudes is too few to render a change advisable for their convenience. But a zero at the freezing point is a serious evil, involving so much labor in placing signs of positive and negative, and so much error in the use of them as justly to demand a new scale were there none better.

But has the Centigrade scale no advantage over that of Fahrenheit in virtue of its centesimal division? I answer, none whatever—absolutely none. Decimal sub-divisions are a great convenience, and it is to be hoped that the first examples of each—the American coin and the French weights and measures—may soon become universal but such convenience is not promoted by the Centigrade scale, which has no subdivisions. For every day thousands multiply and divide by 12, because 12 makes a dozen, 12 lines make an inch, 12 ounces a pound, and 12 pence a shilling; no one ever yet multiplied by 32, because it is the freezing point, or divided by 212, because that is the boiling point. Let us then adhere to our present scale so long as it shall be the best extant, and not, by grasping at the shadowy advantages of a centesimal division, lose the substantial good of small degrees and a zero below the ordinary range of atmospheric temperature.

ON THE FROZEN WELLS OF OWEGO, N. Y.

At the last meeting of the American Association, Professor Brocklesby read accounts of frozen wells in Tioga County, New York, one of which, situated in a table-land, 30 feet above the level of the Susquehanna, has ice in it the year round. The well has been dug 21 years; depth from surface to the ice 61 feet. Ice could not be broken by a heavy weight attached to a rope; thermometer descended 38° in 16 minutes; men can not endure to work more than two hours in the well, and a candle let down shows a deflection of the flame in one direction, proving the existence of a current of air. A large piece of ice was drawn up July 25, 1837. No other wells are within 60 or 80 rods, and none present similar phenomena. A gentleman in Owego has

since discovered two wells in that village, 60 feet deep, which freeze up. They are situated a short distance from the Susquehanna, and below its bed.

In the discussion which followed, Professor Guyot said he had observed on the Jura a number of *ice caves.* One was 60 feet deep. At the opening, columns of ice had formed, falling to the bottom. His explanation was, that in places nearest of access to the snows in winter, we are sure to find ice in summer, if the quantity of snow was large enough. In the case of Mr. Brocklesby's well, the place admits large quantities of snow, which melts, but not readily, because it is not accessible to the sun. It therefore goes through the process which the glaciers of the Alps undergo. The snow freezes again during the night, after being partly melted; and we have the formation of the glacier without movement. It is exactly the same in this as in the Alps.

Professor W. B. Rogers cited similar occurrences in a range of mountains composed of a porous sand rock in Southern Virginia. But he could not see that any accumulation of snow at the bottom of a well should generate ice about its sides. He could, however, well imagine this condition of things, viz: That if the atmosphere became very much chilled, the well becomes the recipient of the coldest air in the neighborhood, on account of its greater specific gravity. The temperature of the well in such case becomes perfectly abnormal, and because of the bad conducting power of its materials retains the cold. This was his explanation.

Professor Denison Olmstead held that very cold air exists in the interior of the earth, which may find a ventilating shaft in the well. In ice houses wastage is prevented by allowing a current of air to pass freely, rather than to permit the ice to be closely housed. Liquefaction after congelation is a very slow process.

Professor Agassiz questioned whether any very low temperature exists in ice resting upon other bodies. When attempting to ascertain the temperature of the Glaciers, by running a thermometer ten feet below the surface, he had failed to find any thing but a fraction of a degree below 32°. A self-registering thermometer, sunk 20 feet below the glacial surface, remained there all winter, and indicated no such temperature as we would be ready to admit as possible under influences so intensely cold.

Professor Henry said that during the past winter he had been struck with the fact that pieces of ice wrapped in a cloth were frozen to it, although not one out of the several thermometers would go down to 32°. It appeared from this, as from the old observation of La Place, who found that the ice surrounding the worm through which they were transmitting gases was soon frozen to the worm, that melting ice produced a certain degree of cold.

Professor Guyot stated that the ice caves which he had referred to were 3,000 feet above the level of the sea, where the quantity of falling snow was very great.

Professor Brocklesby could not see the analogy between an ice cave and a frozen well. The temperature of deep wells generally being about the mean temperature of the place; the temperature of wells in Owego would not vary much from 46° or 47°. He did not think that the phenomenon had been explained.

Dr. Gould alluded to the ordinary method of freezing ice together by mere juxtaposition. It was his fortune to have a friend who was particularly fond on warm days of refreshing himself with a very highly iced beverage in which the ice was present in very small pieces compounded in various ways, and sometimes eaten with a spoon, though that was not the ordinary method. His experience was that pieces of ice frequently adhered to the spoon and that too although the mixture was not one of pure water but sometimes an alcoholic one.

Mr. Hill suggested that the phenomenon alluded to by Professor Henry and Dr. Gould was due to crystallization. With regard to ice going down below the freezing point he had the testimony of scientific witnesses to the fact that ice gathered in Tennessee would not keep so long as that gathered in New Hampshire and Massachusetts.

Professor Henry said that the fact presented by Dr. Gould was also referred to him by the same gentleman, who was also a friend of his. He repeated the experiment. [Laughter.] To produce a perfect experiment it was necessary that all the conditions should be observed. [Renewed Laughter.] He must therefore give them: Sugar and wine and water were mingled with ice, but instead of depending upon the taste he introduced a thermometer, and observed a reduction. With strong alcohol he obtained a still greater reduction, showing that alcohol has so great an affinity for water that it melts the ice—that this is a freezing mixture.

Professor Agassiz explained the different kinds of ice. First was that produced by the freezing of the surface of the water and successive layers of water beneath it, a laminated schistose mass. Into this, bubbles from the bottom of the pond were frequently frozen, and when it was subjected to the action of the sun the bubbles became heated, melted the ice around them and rendered it of no marketable value. It would therefore be worth while for ice gatherers to cover their ponds with cloths, or something which would prevent these bubbles from rising. Glacier ice was formed like pudding-stone; compact masses being cemented together so that when you exposed a large lump of glacier ice to the heat of the sun it would crumble in pieces. It was like the decomposition of conglomerate; we had ice-sand. Icebergs could be determined to be derived from glaciers and not to be the frozen surface of the ocean by their conglomerate composition. Pebbles in glaciers becoming heated melted the ice beneath them and quarried their way down to where the heat of the sun could not reach them. The pot holes formed in this way were soon covered with a thin film of ice, but it was only during the protracted cold of winter that they were frozen through.

RESISTANCE OF AIR TO THE FLIGHT OF PROJECTILES.

The subject of projectiles for the purposes of war naturally excites, at this moment, peculiar interest, and has led to inquiries as to the nature of the resistance of the air as the medium through which they move. Air is highly elastic, and, at the level of the ocean, presses uniformly with the force of about 15 lbs. on the square inch of surface. It has been ascertained that air, under

this natural pressure, will rush to fill a vacuum with a velocity of from 1200 to 1400 feet in a second. It has been, accordingly, conceived that when a solid substance, such as a cannon-ball or rocket, is moving through the atmosphere with a greater velocity than 1400 feet in a second, a vacuum will be produced in its rear as it passes forward. Sir Howard Douglas and other eminent authorities on gunnery, seem to have adopted this theory; but we perceive that it is questioned and denied by Colonel Parlby, of the Bengal Artillery, who considers it a popular error to suppose that there is any vacuum left behind a solid projectile. It is well known that whenever there is a vacuum produced in the air by thunder, by the violent detonation of any powerful chemical compound, or from any other cause, sound more or less loud is produced by the particles of air collapsing upon each other. If there were, therefore, any vacuum created behind a projectile in its flight, it would necessarily be accompanied, during the whole of its passage through the air, with a noise resembling thunder, so long as its velocity continued to exceed 1400 feet in a second. While a cannon-ball or other projectile remains stationary, the atmosphere will press equally upon every part of the surface; but supposing it to move at the rate of 700 feet in a second, or with half the velocity with which air is supposed to rush into a vacuum, then the air will be a resisting medium in front, and an equivalent assisting medium in the rear. Colonel Parlby conceives that, when the velocity reaches 1400 feet, as the air is highly elastic, it rushes round the ball with a whirlpool rapidity; and that, under this high pressure in front, the velocity with which the particles of air move to the rear of the ball will be regulated by that pressure, and not by the uniform velocity of 1400 feet in a second. Coupling the absence of any succeeding loud noise with the above theory, Colonel Parlby comes to the scientific conclusion that there can not be any vacuum left behind a projectile at a velocity at which we can propel it.

EFFECTS OF GUNPOWDER EXPLOSIONS.

At the American Association, Prof. Olmstead read a paper on the Wilmington Gunpowder Explosion of May 31st, 1854. On that day, as three wagons from Dupont's Mills were passing through Wilmington, Del., each with 150 barrels of Gunpowder, about 12,000 pounds, they exploded, demolishing buildings and destroying life. Such wagons were accustomed to pass that route daily for fifty years. The regulations prescribed had fallen into disuse. They had left the mill at distances of half an hour, but had got within twenty-five feet of each other. Wishing to trace out analogies between this explosion and some phenomena of tornadoes, Professor Olmstead wrote to Bishop Lee, whose house was destroyed, and received in answer from his son some interesting facts. The cause of the explosion does not appear, but it is known that two of the men were smoking by the side of their teams. Some of the phenomena were surprising. A splinter from a Venetian blind was blown through an inch board, making as smooth a hole as if pointed with steel. Metals were often displaced. The shoes were torn off the horses' feet, castors from furniture, and hinges from doors, and a wagon-tire was torn off and straightened, and one piece left on a hill a quarter of a mile off. Windows were destroyed

for the distance of more than a mile. Those near the spot were burst in, those further off had the nearest windows burst in, the others out; those further off were all burst out. A piano open near the spot was little injured; one *closed*, further off, was burst open and nearly ruined. The effect on the animal system was to produce a sense of suffocation at first, and afterward soreness of the throat, or even hemoptysis. Many were carried some feet and dropped erect. A man on horseback was lifted out of the saddle and dropped into it again. But the most wondrous effect was exhibited by three depressions where the wagons had stood. The one under the middle wagon was ten feet by five, and three feet deep. It appeared that the earth (Macadamized) had not been removed, but condensed. Professor Olmstead knew of no instance of greater power, even in the great explosion of Brescia, where two millions of pounds of powder exploded, that equaled this. Iron water pipes were broken four or five feet under ground. In the New Haven tornado of 1839, a piece of bureau was carried half a mile and found sticking into a barn, having penetrated through a thick plank. Feathers have been stripped off of fowls, and a woman washing found herself and her tub, with its water, in the cellar, while some of the clothes she was washing were found beyond West Rock, a distance of two miles. Fowls have been known to be stripped of their feathers in such tornadoes.

Professor Mahan said that sappers and miners had a rule that the lateral force of an explosion of a mine would destroy the works at three or four times the distance to the surface, and the downward force would do the same to three quarters the distance of the surface.

Professor Henry said, that the explanation of the blowing off of the horses' shoes he found in simple *inertia*. The shoes were not blown away from the dead horse, but the horses were blown off the shoes; the gravity of the shoe being seven, while the specific gravity of the whole horse is about one.

Mr. William C. Redfield saw no satisfactory evidence of a vacuum. Causes are often mistaken, but he had never found any clear evidence of a vacuum, though too much had been attributed to such a cause.

Professor Brainard thought many phenomena resembled those of electricity, as stripping doors of their hinges and birds of their feathers.

Professor Loomis thought the indentation in the ground was analogous to the process for submarine explosions, only as the resistance of water is greater than air the force is proportionally greater. As to feathers, the loss of them has been attributed to vacuum, but a fowl suddenly exposed to vacuum loses no feathers. Professor Loomis put a live fowl into a gun of two-inch bore, with a sixth of a charge of powder, and aimed at zenith. It came down denuded of feathers, and mangled by using more powder than was necessary.

Professor Johnson thought there was an analogy between the indentation of gunpowder here and that often exhibited by more violent fulminates. Two ounces of fulminating mercury will perforate an inch plank when there is nothing to oppose it in any direction.

Professor Rogers thought that there never could be any condensation of air by explosion without a subsequent rarefaction, and that vacuum played a necessary part of the phenomena of tornadoes.

Judge Osborn gave some curious circumstances about sand-blasting. The hole is not to be entirely filled, and the sand should be dry. Dry chaff may be substituted for sand, and would be better than wet sand. At an explosion he noticed that those who were furthest from the explosion were thrown furthest and least injured. The nearer ones were moved little, but denuded and mangled.

ON MECHANICAL NOTATION.

The following paper on the mechanical notation to be used in describing machinery, was read before the British Association, Glasgow Meeting, by Mr. Babbage. The method proposed is one of great importance to all engaged in the construction and description of machinery, since without the aid of mechanical notation it would be beyond the power of the human mind to master and retain all the details of complicated machinery.

"To understand the construction of a machine, we must know the size and form of all its parts—the time of action of each part—and the action of one part on another throughout the machine. The drawings give the form and shape, but they give the action of the parts on each other very imperfectly, and nothing at all of the time of action. The notation supplies the deficiency, and gives at a glance the required information. Having made the drawings of a machine, we must assign letters to the different parts. Hitherto, I believe, this has been left to chance; and each one has taken the letters of the alphabet, and used them with little or no system. With respect to lettering, the first rules are, that all framework shall be represented by upright letters. Movable pieces shall be represented by slanting letters. Each piece has one or more working points—each of the working points must have its own small letter—the working points of framework having small printed letters, and the working points of the movable pieces having small written letters. We have the machinery divided into framing, indicated by large upright letters; movable pieces by large slanting letters; working points of framing indicated by small printed letters; working points of movable pieces indicated by small written letters. In letter drawings the axes are to be lettered first. Three alphabets may be used—the Roman, Etruscan, and written. These should be selected as much as possible so that no two axes which have arms or parts crossing each other shall have letters of the same alphabet. Having lettered the axes, all the parts on them, whether loose or absolutely fixed to them, must be lettered with the same alphabet, care being taken that on each axis the parts most remote from the eye shall have letters earlier in the alphabet than those parts which are nearer. It is not necessary that the letters should follow each other continuously, as in the alphabet;—for instance, D, L, T. may represent three cog-wheels on the same axis; D must be the most remote, L the next, and T the nearest. The rule is, that 'on any axis, a part which is more remote from the eye than another, must invariably have a letter which occurs earlier in the alphabet.' By this system very considerable information is conveyed by the lettering on a drawing; but still more to distinguish parts and pieces, an index on the left hand,

upper corner, is given to each large letter; this is called the 'index of identity,' and all parts which are absolutely fixed to each other must have the same index of identity; no two parts which touch, or interfere with, or cross each other, on the drawings, must have the same index of identity. This may generally be done without taking higher numbers than 9. All pieces which are loose round an axis must have a letter of the same character, Roman, Etruscan, or writing; but a different index of identity will at once inform us that it is a separate piece, and not fixed on the axis. I shall now endeavor to explain how the transmission and action of one piece on another is shown, beginning from the source of motion. Each part is written down with its working points; those of its points which are acted on are on the left-hand side; those points where it acts on other pieces are on the right hand; if there are several, a bracket connects the small letters with the large. The pieces being arranged, arrow-headed lines join each acting or driving point of one piece with the point of another piece, which it drives or acts on. It is usually necessary to make two or three additions when a machine is complicated, before all the parts can be arranged with simplicity; but, when done, 'the trains,' as they are called, indicate with the utmost precision the transmission of force or motion through the whole machinery, from the first motive power to the final result. It is, however, one of the principles of the notation to give at one view the greatest possible amount of information, so long as no confusion is made; and it has been found that without in any way interfering with the simplicity of 'the trains,' a great deal more information may be conveyed. For instance, while looking at 'the trains,' it is often convenient or necessary to know something of the direction of the piece under consideration, and, by the use of a few signs placed under the large letters, we can convey nearly all that is wanted in this respect. Again, though the drawings of a machine are specially intended to give the size and shape of each piece, yet by the use of some signs of form which are placed over the letters, the shape of each piece may be indicated. It is found that these signs do not confuse the trains; but on the contrary, extend their use by making the information they convey more condensed, and more easily accessible. I now pass to 'the cycles' as they are termed, or to that part of the notation which relates to the time of action of the different parts of a machine. 'The cycles' give the action of every part during the performance of one complete operation of the machine, whatever that may be. Each piece has a column of its own, and the points by which it is acted on are placed on its left hand, and the points by which it acts on other parts are placed on its right; and each working point has also its own column. The whole length of the column indicates the time occupied in preparing one operation, and we divide that time into divisions most suited to the particular machine. During each division of time that a piece is in motion, an arrow up and down its column indicates the fact; and during the time of action of each working point, an arrow in its column shows the duration of its action. The times thus shown are, of course, only relative and not absolute time; but it would be easy to show both, by making the divisions of the column correspond with the number of seconds or minutes during which the machine performs one operation.

The arrows which point upward indicate circular motion in the direction screw in, and the arrows which point downward, screw out; where the motion is linear, the downward arrow indicates motion from right to left."

CHAUVENET'S GREAT CIRCLE PROTRACTOR.

One of the most valuable nautical instruments recently invented is the "Great Circle Protractor," of Professor Chauvenet, of the United States Naval Academy. It consists of a circular chart of the meridians and parallels of latitude of the globe, in a form familiar to all navigators; on which is centered a thin transparent revolving-chart, representing to the eye the great circles which pass through any given points on the lower chart. It gives by inspection, without the aid of scales, compasses, or other instruments, the great circle or shortest route from place to place—the distance as well as the course being read off from the Chart or Protractor; also the latitude and longitude of all intermediate places. In sailing with head winds, the navigator can see at a glance which is the best track to sail upon. The chart itself contains all necessary directions, and is quite portable, being only 18 inches square. It gives the azimuth and amplitude of the sun or a star with all necessary precision, and a sufficient approximation to the time and latitude to serve as a check to the ordinary calculations. To get the latitude from a meridian altitude of the sun, the navigator has only to "set the point W. on the declination of the sun, take the parallel of distance on the *transparent chart*, which corresponds to the altitude of the sun, counting from the line of courses toward W., follow this parallel to the edge of the *fixed chart*, and read off the latitude of the ship." It is true that no saving of time is gained by this particular process, but it is useful as a check to the usual calculations. Having the time from noon by the chronometer or otherwise, and the sun's altitude, a simple inspection of the chart shows the latitude. The time at the ship is also found by inspection from the altitude.

NEW SURVEYING INSTRUMENT.

An apparatus for delineating sections of surveys for rail-roads, canals, etc., and for computing the solid contents of cuttings and fillings, was exhibited by M. Collin & Wagner, at the Paris Exhibition. It consisted of a standard three feet high, supported on a carriage having three wheels. From this standard there was suspended a pendulum, the rod of which extended beyond the suspension-point and there actuated a series of levers as it vibrated. When it was desired to delineate a section of a rail-road survey, it was drawn on the ground, on the proper line, and of course the undulations gave a proportionate amount of vibration to the pendulum, which again actuated the series of peculiarly combined levers mentioned. One of them operated a pencil, and traced the undulating line of the road on a piece of prepared paper, which was wound off on a cylinder. The other two moved counters constructed on the principle of a calculating machine, which showed the actual amount of solid contents to be excavated, from elevations, and the fillings-up to be made in depressions of the road to a specific level.

BAROMETRIC ANOMALIES ABOUT THE ANDES.

Lieutenant Maury, in a communication to *Silliman's Journal*, gives the following account of some very curious barometric anomalies observed by Lieutenant Hernden in the vicinity of the Andes of South America. This officer, who explored the Valley of the Amazon, and determined the heights of various places above the level of the sea, both by barometric pressure and by the boiling-point of water, states that at the eastern base of the Andes he found the pressure of the atmosphere, as measured by the temperature of boiling water, to be nearly as great as it is usual at the sea level; and after having *descended* the river for nearly a thousand miles below this place of great pressure, he found that, judging by the boiling-point of water, he had *ascended* nearly 1,500 feet. The explanation offered by Lieutenant Maury of this phenomenon is as follows: The Andes extend from 3 to 5 miles up into the atmosphere. The trade winds blow almost perpendicularly against them, of course these winds are obstructed by an obstacle which extends as far up, or nearly as far up, as they themselves do; and being thus obstructed in their course, would produce a banking up of air against their slopes, as there is of water against a rock or other impediment over which the current of a rapid river has to force its way. In such case there would be a ridge or pile of water above the obstruction, and a depression or hollow in the water both above and below this ridge. The same effect is doubtless produced in the atmosphere. Admitting this to be true, we derive a practical rule that the height of a chain of mountains, determined by barometric pressure, depends upon the way the wind blows.

NEW PLANETARIUM.

Mr. J. W. Hatch of Utica has nearly ready a Planetarium, the largest ever constructed in the United States. In this model the planets are made to revolve in vertical orbits. These are projected on a screen or medium, behind which all the machinery is concealed, so that there appears no visible sustaining power between the planets and the sun. The whole is arranged with folding-curtains, by which the celestial scenery can be brought on with theatrical effect. The eclipses of the satellites take place as they come into that part of their orbits relative to the sun to produce those results. The great comet of 1680 is represented traversing an elliptic orbit through a circuit of 50 feet.

NEW HYGROMETRIC REGULATOR.

A hygrometric regulator exhibited at the Fair of the American Institute by Dr. Joel H. Ross, is designed to equalize the condition of the air with regard to moisture, irrespective of temperature. Dr. Ross's plan is especially designed for buildings warmed by steam-pipes. He attaches a cock to blow a stream of vapor into the room, and makes the cock self-adjusting by the aid of a weight and a long linen string. The weight continually strives to open the cock, while the string restrains it; but as the linen fibers are contracted by

every accession of moisture and lengthened as the air becomes too dry, it follows that the cock is alternately opened and closed, according as the air in the building requires more or less moisture.

ACCURACY OF THE CHINESE AS OBSERVERS.

At a recent meeting of the Chinese Asiatic Society, Dr. MacGowan remarked that the subject of Snow Crystals, which engaged considerable attention last winter in England, had come under the notice of Chinese observers; that from a remote period there has been an axiomatic expression met with in their conversation and books, to the effect that "snow-flakes are hexagonal," which, like their knowledge of the *acarus* in the cuticle of persons affected with itch (figured and described by their medical writers long before Western pathologists admitted the existence of that parasite), shows, among many similar cases, that the Chinese are accurate observers of nature.

ON THE STRENGTH OF BUILDING MATERIALS.

At the Providence meeting of the American Association Professor Henry read a paper on the modes of testing building materials, and an account of the marbles used at Washington. He had been appointed on a committee to test the materials offered for the extension of the Capitol at Washington. The committee had to take into consideration many minute sources of disintegration, such as that every flash of lightning produced an appreciable amount of nitric acid, which diffused in rain-water acted on the carbonate of lime and the action of dust carried by the wind against the building. The committee subjected specimens to actual freezing, and after several experiments a good method was obtained. It was found that in ten thousand years one inch would be worn from the blocks by the action of frost. Blocks of one and a half inch cube were subjected to pressure, and thin plates of lead, as had been the case in former experiments, being introduced to equalize any inequalities which might occur in the surfaces. But upon experiment it was found that while one of these cubes would sustain 60,000 pounds without the lead plates it would sustain only 30,000 with them. They had therefore to invent a machine to cut the sides of the block perfectly parallel, when it was found that the marble which was chosen for the Capitol, from a quarry in Lee, Massachusetts, would sustain about 25,000 pounds to the square inch. The manner of its breaking was peculiar. With the lead plates interposed, the sides, which were free, first gave way, leaving the pressure on two cones whose bases joined the plates, and whose apexes met each other, and that they then yielded with comparative ease. This marble absorbed water by capillary attraction, and in common with other marbles was permeable to gases. Soon after the workmen commenced placing it in the walls it exhibited a brownish discoloration, although no trace of it appeared while the blocks remained in the stone-cutter's yard. A variety of experiments were made with a view to ascertain the cause of this phenomena, and it was finally concluded to be due to the previous absorption by the marble of water holding in solution organic

matter, together with the absorption of another portion of water from the mortar. To illustrate the process, he supposed a fine capillary tube with its lower end immersed in water, whose internal diameter was sufficiently small to allow the liquid to rise to the top to be exposed to the atmosphere. Evaporation would take place at the upper surface of the column, and new portions of water would be drawn up to supply the loss, and if this process were continued any material which might be contained in the water would be found deposited at the top of the tube, the point of evaporation. If, however, the lower portion of the tube were not furnished with a supply of water, the evaporation at the top would not take place, and the deposition of foreign matter would not be exhibited, even though the tube itself were filled with water impregnated with impurities. The pores of the marble, so long as the blocks remained in the yard, were in this last condition, but when the same blocks were placed in the wall of the building, the water absorbed from the mortar at the interior surface gave the supply of liquid necessary to carry the coloring materials to the exterior surface, and deposit it there at the mouths of the pores. The cause of the phenomenon being known, a remedy was readily suggested; the interior surface of the stone was coated with asphaltum, rendering it impervious to the moisture of the mortar, and the discoloration was gradually disappearing. In a series of experiments made some ten years ago he had shown that the attraction of the particles for each other of a substance in a liquid form was as great as that of the same substance in a solid form. Consequently, the distinction between liquidity and solidity did not consist in a difference in the attractive power occasioned directly by the repulsion of heat; but it depended upon the perfect mobility of the atoms, or a lateral cohesion. He might explain this by assuming an incipient crystallization of atoms into molecules, and consider the first effect of heat as that of breaking down these crystals and permitting each atom to move freely around every other. When this crystalline arrangement was perfect, and no lateral motion was allowed in the atoms, the body might be denominated perfectly rigid. We had approximately an example of this in cast steel, in which no slipping took place of the parts on each other, or no material elongation of the mass; and when a rupture was produced by a tensile force, a rod of this material was broken with a transverse fracture of the same size as that of the original section of the bar. In this case every atom was separated at once from the other, and the breaking weight might be considered as a measure of the attraction of cohesion of the atoms of the metal. The effect, however, was quite different when we attempted to pull apart a rod of lead. The atoms or molecules slipped upon each other. The rod was increased in length and diminished in thickness until a separation was produced. Instead of lead we might use still softer materials, such as wax and putty, until we arrived at a substance in a liquid form. This would stand at the extremity of the scale, and between extreme rigidity on the one hand and extreme liquidity on the other, we might find a series of substances gradually shading from one extremity to another. According to the views he had presented, the difference in tenacity of steel and lead did not consist in the attractive cohesion of the atoms, but in their capability of slipping upon each other. From this view it followed that the

form of the material ought to have some effect upon its tenacity, and also that the strength of the article depended in some degree upon the process to which it had been subjected. He had, for instance, found that softer substances in which the outer atoms had freedom of motion, while the inner ones by the pressure of those exterior were more confined, broke unequally, the inner fibers, if he might so call the rows of atoms, gave way first and entirely separated, while the exterior fibers showed but little indications of a change of that kind. If a cylindrical rod of lead, three fourths of an inch in diameter, were turned down in a lathe in one part to about half an inch, and then gradually broken by a force exerted in the direction of its length, it would exhibit a cylindrical hollow along its axis of half an inch in length, and at least a tenth of an inch in diamcter. With substances of greater rigidity this effect was less apparent. It existed, however, even in iron, and the interior fibers of a rod of this metal might be entirely separated, while the outer surface presented no appearance of change. From this it would appear that metals should never be elongated by mere stretching, but in all cases by the process of wire-drawing or rolling. A wire or bar must always be weakened by a force which permanently increases its length without at the same time compressing it. Another effect of the lateral motion of the atoms of a soft heavy body when acted upon by a percussive force with a hammer of small dimensions in comparison with the mass of metal, was that the interior portion of the mass acted as an anvil upon which the exterior portion was expanded so as to make it separate from the middle portions. Professor Henry exhibited a portion of bar originally four feet long, which had been hammered in that way so as to produce a perforation through the whole length of its axis, rendering it a tube. This fact appeared to him to be of great importance in a practical point of view, as it might be connected with many of the lamentable accidents which had occurred in the breaking of the axles of locomotive engines. These ought in all cases to be formed by rolling, and not with the hammer.

ON THE PECULIARITIES OF CERTAIN LOCALITES IN CITIES.

Most persons think that the reason why the west end of London is more fashionable than the east is nothing more than the topographical figuration of the capital. But the Academy of Sciences at Paris, at a recent session, pronounced this opinion to be a delusion. In the first place, it appears that it is not only at London, but at Paris, Vienna, Berlin, Turin, St. Petersburg, and almost every other capital in Europe—at Liege, Caen, Montpellier, Toulouse, and several other large towns—wherever, in fact, there are not great local obstacles—the tendency of the wealthier inhabitants to group themselves to the west is almost as strongly marked as in the "Great Metropolis." In the second place, at Pompeii and other ancient towns the same thing may be noticed; and, in the third place, where the local figuration of the town necessitates an increase in a different direction, the moment the obstacle ceases houses spread toward the west. This last fact may, it is stated, be particularly observed at Rome, and, to a certain extent, at Edinburg. When, then, all cities and towns have their best districts in the west, it is pretty clear that

the cause of it must be some general law entirely distinct from local situation. What is that law? "It arises from the atmospheric pressure," answers the Academy of Sciences. "When," it continues, "the barometric column rises, smoke and pernicious emanations rapidly evaporate in space. In the contrary case we see that smoke and pernicious vapors remain in apartments and on the surface of the soil. Now, every one knows, that of all winds, that which causes the greatest ascension of the barometric column is that of the east, and that that which lowers it most is the west. When the latter blows, it has the inconvenience of carrying with it to the eastern parts of a town all the deleterious gases which it meets in its passage over the western parts. It results from that that the inhabitants of the eastern part of a town have to support not only their own smoke and miasma, but those of the western part of the town, brought to them by the western winds. When, on the contrary, the east wind blows, it purifies the air by causing to ascend the pernicious emanations which it can not drive to the west. Consequently, the inhabitants of the west receive pure air from whatever part of the horizon it may arrive; and it may be added that, as the west winds are those which most frequently prevail, they are the first to receive the air pure, and as it arrives from the country." After thus explaining why the western parts are the best, the Academy makes these recommendations:—1. That persons who have the liberty of choice, and especially those of delicate health, should reside in the western parts of towns. 2. That all establishments from which emanate pernicious vapors and gases should be placed in the east. 3. That in building a house in a town, and even in the country, the kitchens and other dependencies from which pernicious emanations may arise should be placed to the east. The members of the Academy who have announced the preceding discovery, and made the preceding recommendations, are Messrs. Pelouze, Pouillet, Boussingault, and Elie de Beaumont—all of them of European reputation as *savants*.

ON CERTAIN CURIOUS MOTIONS OBSERVABLE ON THE SURFACES OF WINE AND OTHER ALCOHOLIC LIQUORS.

The following is an abstract of a paper on the above subject read at the last meeting of the British Association by Mr. J. Thomson:—The phenomena of capillary attraction in liquids are accounted for, according to the generally received theory of Dr. Young, by the existence of forces equivalent to a tension of the surface of the liquid, uniform in all directions, and independent of the form of the surface. The tensile force is not the same in different liquids. Thus it is found to be much less in alcohol than in water. This fact affords an explanation of several very curious motions observable, under various circumstances, at the surfaces of alcoholic liquors. One part of these phenomena is, that if, in the middle of the surface of a glass of water, a small quantity of alcohol, or strong spirituous liquor, be gently introduced, a rapid rushing of the surface is found to occur outward from the place where the spirit is introduced. It is made more apparent if fine powder be dusted on the surface of the water. Another part of the phenomena is, that if the sides

of the vessel be wet with water above the general level surface of the water, and if the spirit be introduced in sufficient quantity in the middle of the vessel, or if it be introduced near the side, the fluid is even seen to ascend the inside of the glass, until it accumulates in some places to such an extent that its weight preponderates, and it falls down again. The manner in which Mr. Thomson explains these two parts of the phenomena is, that the more watery portions of the entire surface, having more tension than those which are more alcoholic, drag the latter briskly away, sometimes even so as to form a horizontal ring of liquid high up round the interior of the vessel, and thicker than that by which the interior of the vessel was wet. Then the tendency is for the various parts of this ring or line to run together to those parts which happen to be most watery, and so that there is no stable equilibrium, for the parts to which the various portions of the liquid aggregate themselves soon become too heavy to be sustained, and so they fall down. The same mode of explanation, when carried a step further, shows the reason of the curious motions commonly observed in the film of wine adhering to the inside of a wine-glass when the glass, having been partially filled with wine, has been shaken so as to wet the inside above the general level of the surface of the liquid; for, to explain these motions, it is only necessary further to bring under consideration that the thin film adhering to the inside of the glass must very quickly become more watery than the rest, on account of the evaporation of the alcohol contained in it being more rapid than the evaporation of the water. On this matter Mr. Thomson exhibited to the Section a very decisive experiment. He showed that in a vial partly filled with wine, no motion, of the kind described, occurs as long as the vial is kept corked. On his removing the cork, however, and withdrawing, by a tube, the air saturated with vapor of the wine, so that it was replaced by fresh air capable of producing evaporation, a liquid film was instantly seen as a horizontal ring creeping up the interior of the vial, with thick-looking pendant streams descending from it like a fringe from a curtain. He gave another striking illustration by pouring water on a flat silver tray, previously carefully cleaned from any film which could hinder the water from thoroughly wetting the surface. The water was about one tenth of an inch deep. Then, on a little alcohol being laid down in the middle of the tray, the water immediately rushed away from the middle, leaving a deep hollow there, which laid the tray bare of all liquid, except an exceedingly thick film. These and other experiments, which he made with fine lycopodium powder dusted on the surface of the water, into the middle of which he introduced alcohol gently from a fine tube, were very simple, and can easily be repeated. Certain curious return currents, which he showed by means of the powder on the surface, he stated he had not yet been able fully to explain.

INTERESTING PHILOLOGICAL DISCOVERIES.

At a recent meeting of the Asiatic Society, London, a communication was read from Mr. Hodgson, who is at present residing in Central Asia for the purpose of philological research. The writer has obtained thirty new vocab-

ularies from Tibet, Horsok, and Sifan, and by their aid he has completed a comparative analysis of all the languages of this class, reaching nearly over the whole globe, in which he finds a perfect uniformity of the laws regulating the composition of words and their arrangement, extending over the whole class The paper stated briefly some of the results arrived at, leaving the data for further communication at full length. The following are some of its results: The old dogma which Horne Tooke fancied he had discovered, that all the numerous words which we generally call particles, such as prepositions and conjunctions, and the syllables and letters which modify root words in the way of derivation, conjugation, and declension, were originally vital words, having definite meanings, is perfectly true of the Tartar tongues, and the fact is found in them in every stage of development. The distinction between monosyllabic and polysyllabic languages is without foundation, polysyllables being merely iterations and accretions of monosyllables; and the languages do, in fact, graduate into each other. The researches of Mr. Hodgson demonstrate the affinity of the Sifan, Horsok, Tibetan, Indo-Chinese, Himalayan, and Tamulian tongues, by identity of roots, identity of compounds, and, above all, by the absolute uniformity of the laws regulating them. All the Tartar tongues, from America eastward, through the Old World to Oceania, constitute one great family. All the Tamulian languages, and those of the aboriginal tribes of India, are of one class, and that class is Tartar. All derive their vocables from the Northern tongues, either directly or viâ Indo-China, and the routes or relative lines of passage are plainly traceable. A great many Arian vocables, even in Sanscrit, are Tartar, as well in their composite and ordinary state as in their roots. Mr. Hodgson is finally of opinion that the Tartar tongues, taken all together as a great unity, throw a brilliant light on the state of language in general, as it existed prior to the great triple division into Semitic, Iranian, and Turanian languages.

CHEMICAL SCIENCE.

ON THE CHEMICAL EQUIVALENTS OF CERTAIN BODIES, AND THE RELATIONS BETWEEN OXYGEN AND AZOTE.

THE following is an abstract of a paper recently read before the Royal Society of Edinburgh, by Professor Low:

The author commences his paper with a review of the opinions entertained by Dalton, Berzelius, and others, regarding the equivalent numbers of hydrogen, oxygen, nitrogen, and carbon, which have been differently fixed according as we start from combination by weight or by volume. He remarked that while either view was perfectly suited to explain all the general phenomena of decomposition, yet since chemists had begun to examine the phenomena of substitution, it became apparent that it was absolutely necessary to employ the equivalents determined by weight. The author then proceeds to show that on a proper comparison of the properties of these elements, and of the constitution of their compounds, their atomic weight must be hydrogen 1, carbon 6, nitrogen 7, oxygen 8.

Reference is then made to the nature of azote, and to the opinion more than once expressed since its discovery in 1772, that it might be a compound, and to the views of Davy and Berzelius, the latter of whom supposed it must contain an inflammable base, which he proposed to term nitricum. The author stated that he had long since arrived, by an entirely different line of argument, at the conclusion that nitrogen was a compound substance containing carbon; and as no other element can possibly combine with that substance so as to produce a compound whose equivalent shall be 7, except hydrogen, he concludes that azote is actually represented by the formula C H. Pursuing the same line of argument, he pointed out that oxygen might be a compound of azote and hydrogen, and referred to certain properties of azote as indicating its compound nature. The author concludes his paper by showing how, in all probability, other elements might actually be considered as compounds, referring particularly to selenium and tellurium, chlorine, iodine, and bromine, and the metallic basis of the alkaline earths and alkalies.

ON THE ABSORPTION OF MATTER BY THE SURFACES OF BODIES.

At the meeting of the British Association, Sir David Brewster stated that if we smear, very slightly with soap, the surface of a piece of glass, whether

artificially polished or fused, and then clean it perfectly with a piece of chamois leather, the surface, when breathed upon, will exhibit, in the most brilliant manner, all the colors of thin plates. If we breathe through a tube, the colors will be arranged in rings, the outermost of which is black, corresponding to the center of the system of rings formed between a convex and a plane surface. In repeating this experiment on the surfaces of other bodies, Sir David found that there were several on whose surfaces no colors were produced. Quartz exhibited the colors like glass, but calcareous spar and several other minerals did not. In explaining this phenomenon, the author stated that the particles of the soap, which are dissolved by the breath, must either enter the pores of the bodies or form a strongly adhering film on their surface. This property of appropriating, temporarily, the particles of soap, becomes a new distinctive character of mineral and other bodies.

PREPARATION OF AMMONIA IN THE SMELTING OF IRON.

The following suggestions from the *London Mining Journal*, by Mr. T. H. Leighton, are worthy of consideration:

"The vapors which escape from iron blast furnaces may be regarded simply as the atmosphere highly charged with carbon, or as a mixture of carbonic oxyd, cyanogen, and nitrogen. When steam, at a sufficiently high temperature, and air excluded, is mingled with these gases, the oxygen of the steam decomposes the cyanogen, and converts the carbonic oxyd into carbonic acid, while the hydrogen and nitrogen combine to form ammonia; thus carbonate of ammonia will result; but as it may prove difficult to condense this effectually, if the vapor of ammonia were conveyed into a chamber charged with an insoluble lumpy material, so arranged that the ammonia, in ascending would come in contact with a cold solution of salt trickling down, carbonate of soda and muriate of ammonia might be at once obtained. If, however, an ample supply of sulphate of iron could be procured, it would be more advisable to fix the ammonia by means of sulphuric acid expelled from sulphate of iron, because at the same time, pure oxyd of iron would be produced, which would prove valuable in the subsequent forging of iron. Alkali refuse should be composed of sulphuret of calcium and coke dust. When this is acted upon by steam with sufficient heat, the oxygen of the steam converts the calcium into lime, while the sulphur and hydrogen pass off as sulphuretted hydrogen. When the latter is mingled with the vapors from a dense purely carbonaceous fire, consisting of carbonic oxyd and nitrogen, the latter combines with the sulphuretted hydrogen, and forms sulphuret of ammonia. If these vapors are then partially cooled down, and a large quantity of cool air admitted, the carbonic oxyd becoming carbonic acid, combines with the ammonia, and disengages sulphur; thus carbonate of ammonia and sublimed sulphur might be obtained. If, on the other hand, the heat of the vapors is maintained, and a large quantity of heated air thrown in, the sulphuret of ammonia is converted into sulphite, which rapidly passes into sulphate of ammonia, by means of which more salt may be decomposed; and thus alkali refuse may be brought to yield sulphate of soda, muriate of ammonia,

and carbonized lime dust. This latter material will be valuable in agriculture; it should be worked into the land when preparing it for seed, muriate of ammonia being afterward applied to the growing crop, when the first shower of rain will carry it into the soil, when carbonate of ammonia will be disengaged in direct contact with the root of the plant. By treating gypsum as sulphate of lime, with small coal and high heat in a reverberatory furnace, it would be reduced to sulphuret of calcium, and may, by a similar mode of treatment, yield the same product as alkali refuse.

REFUSE OF SMELTING FURNACES.

The production of iron by the smelting-furnaces of Great Britain has reached 3,000,000 tons annually; and by a moderate calculation, it may be assumed that for every ton of iron two tons of slag are formed, making an aggregate of at least 6,000,000 tons of this hitherto refuse material. Not only has this vast accumulation of slag been to the present time comparatively useless, but it has proved an incumbrance and source of heavy expense to the ironmasters; for it is calculated that a sum of not less that £150,000 sterling is annually expended by and lost to them in removing the unsightly heaps from their premises, to be used as the most worthless of materials in mending old roads, and in filling gullies and other vacant spaces.

Within the past year, however, a company has been formed in England for the purpose of turning this heretofore waste material to a useful account, under the direction of Dr. W. H. Smith, of Philadelphia, the patentee of the process. In a paper read before the London Society of Arts, Dr. Smith stated that according to the treatment it receives, slag can be rendered brittle or tough, hard or soft, compact or porous, rough or smooth. It can be cast into as great a variety of forms, solid and hollow, as iron itself, with the superior advantage of being susceptible of the admixture and blending of colors, so as to render it equal in brilliancy to agate, jasper, malachite, the variegated marbles, and other more valuable varieties of the mineral kingdom. When properly annealed, it can be made to acquire a surface, or texture, at least 10 times as durable as that of marble, and is susceptible of a polish equal to agate or cornelian. As a building material, slag can be readily adapted to any variety of architectural design, from the simple slab to the most ornate and complex decoration; while its beauty and durability chiefly recommend it as an article of luxury.

Dr. Smith entered into a comparison of the relative expense of the manufacture of clay bricks as compared with that of bricks or blocks of slag; and he reminded us, that in making bricks of the latter, the raw material costs less than nothing, inasmuch as the ironmaster saves by its utilization the heavy expenditure now attendant upon its removal from the furnace premises. In fusing slag for the operation of casting no expense is incurred, inasmuch as this item of expenditure is charged by the metallurgist to the metallic and *not* to the earthy products of the smelting operation; whereas, in making bricks of clay, the raw material has an intrinsic value, while the consecutive operations of digging the clay, preparing it for use, and transporting it, added to

the process of pressing and annealing, consume at least twice as much time and labor as are employed in working slag. "From those simple, yet clear data," observed Dr. Smith, "we can fairly infer that the cost of making clay bricks will be double that of making blocks, tiles, or more decorative and valuable articles from slag. By extending this calculation to other products, such as marble slabs, columns, carved architectural ornaments of stone, etc., and in our estimate contrasting the plastic power of fusion available in slag with the laborious hewing and fashioning by mechanical means required for blocks of marble and other stones, we may arrive at still more satisfactory results in proving the commercial value of slag."

The samples which were exhibited and examined by the auditory excited general admiration, from the closeness of the texture, the height of the polish and the beauty and apparent durability of the articles. Some of them had been made from the slags of American furnaces, others from those of the furnaces of France and England; and it was evident, from their inspection, that the commercial value expressed in the above calculation was by no means extravagant.—*London Mining Journal.*

FUSIBLE SAFETY-PLUGS.

It is well known that plugs of metal composed of some alloy fusible at a comparatively low temperature, have been prescribed for steam-boilers, especially those of the steamboats on our Western waters, so as to insure greater safety to the traveling community, as well as to engineers themselves. Some have contended that these plugs were a perfect protection against too high steam pressure (whereby its heat is increased) and also against low water in boilers; others again have contended that they were of no use whatever, not being uniformly reliable, either as to the degree of heat at which they will melt when new, also by altering their nature entirely when used for some time, so as to be in no manner different from the metal of the boiler itself as it respects melting. This subject being referred by the St. Louis Association of Steamboat Engineers to a committee of its members, they have examined into the matter and made a report of their labors. In that report they mention the experiments with Easton's and Evans's safety-guards of fusible alloys, and point out their uncertainty, and conclude as follows:—

"Finally, after having given this subject our most careful consideration, and after having proven our opinions, by many years' experience as practical engineers, during which we have had the most ample means of determining the value of alloy safety-valves, we have arrived at the candid conviction that they are useless to the engineer, and of no protection to the traveling public. If Congress shall still insist upon the use of fusible alloy safety-guard, we respectfully ask that it will cause such investigation to be made and such manufactures of these alloys established as will insure them to be uniform in operation and satisfactory in their results (if these are practicable), and that the mechanical device, by which the alloy may be applied, be left open to the inventive genius of the country; the best of which to be determined from time to time by some proper and competent authority."—*Scientific American.*

In reference to the above subject, we would add that Professor James C. Booth, of Philadelphia, is now engaged, by the order of government, in an extensive series of experiments on fusible alloys, and their employment in connection with steam-boilers. A report of great value may be anticipated.—*Editor.*

USE OF ZINC FOR THE SHEATHING OF VESSELS.

The Vieille Montagne Company of Belgium are now engaged in manufacturing extensively zinc for the sheathing of vessels. In a pamphlet issued they present testimonials of the use of zinc sheathing in various ships for eight, nine, and even twelve years. The average duration of a zinc suit is, however, fixed at six years. The superiority of the zinc to copper in point of durability is based on the following grounds:—

1. It is used in thicker sheets than either copper or yellow metal.
2. It does not oxydize or corrode, as copper or brass, by immersion in sea-water; on the contrary, it is covered with an adhesive coat of peroxyd, which becomes a permanent protection to the body of the metal.
3. When barnacles or sea-weeds that may have gathered upon it, fall, or are scraped off, the metal remains almost uninjured, while, with a copper or brass sheathing, they commonly leave it greatly thinned, eaten through, and crumbling off.

The cost of copper in sheets, in relation to that of zinc, is generally as $3\frac{1}{3}$ is to 1; if to this be added the well-known fact that a suit of copper sheathing seldom lasts more than four years, the economy of using zinc will be self-evident. The same conclusion applies to brass or yellow metal sheathing, the cost of which is only one sixth less than that of copper, and which is acknowledged seldom to last more than three years.

An attempt has also been made with success, to construct a vessel entirely of zinc. A schooner built of zinc constructed at Nantes, France, in 1854, has since been employed as a regular trader between Marseilles and Rio Janeiro. The zinc plates used overlapped each other one inch, and were riveted with wrought zinc rivets, one and a quarter inches apart.

A zinc vessel, while it is hardly inferior in strength to one of iron, has over the latter many advantages:

1. It will cause no deviation of the compass. 2. The plates not being liable to corrode or rust, do not require painting. 3. In ordinary cases of collision, while iron would in all probability crack or break, causing a leakage in the vessel, zinc would yield and bend without endangering the safety of the vessel and hands, or interrupting her course. 4. In the event of stranding near shore, and in a position and under circumstances allowing salvage, the zinc hull might be cut or sawed in pieces, having a real value, while the iron hull would be abandoned as worthless.

NEW METALLIC ALLOYS.

Messrs. de Ruolz and Fontenay, of Paris, have invented an alloy which may be employed for almost all purposes to which silver is usually employed.

The improved alloy is composed only of silver, copper, and purified nickel; which metals may be combined in any suitable proportions, but the following are preferred:—Silver 20 parts, nickel from 25 to 31 parts, and the rest up to 100 parts in copper. An alloy is thus produced containing 20 per cent., or thereabouts, of silver, and constituting silver of the third degree of fineness, thus reversing the proportions of the ordinary composition of the second degree; this latter containing 800 parts of silver and 200 of alloy, whereas the improved compound contains 200 parts of silver, and 800 parts of alloy. The copper employed must be the purest obtainable in commerce; and the nickel should be purified by some suitable process. Although the proportions above given are those generally employed for the production of the improved alloy, the proportion of silver may be variously increased up to the following limit:—silver 30 parts, nickel 31 parts, and copper 49 parts. Total, 110 parts. It is advantageous, first, to melt the copper and nickel in the granular state, and afterward to introduce the silver; and the flux to be employed in this state consists of charcoal and borax, both in the state of powder; and the ingots obtained are to be rendered malleable by annealing for a considerable time in powdered charcoal. It has also been ascertained that phosphorus can be usefully introduced into these alloys, and, in certain cases, extracted after the required effect has been produced by it. The operation is as follows:—Phosphuret of copper is prepared in the ordinary way, and its richness in phosphorus is ascertained by analysis. This phosphuret of copper is then remelted and granulated; after which the following mixture is melted:—Phosphuret of copper 49 parts (of such a strength as to be capable of introducing into 100 parts of the alloy from 1 to 20-1000ths of phosphorus), nickel 31 parts, and silver from 20 to 40 parts, or more, as desired by consumers. It must be well understood that the silver must not be introduced into the alloy until the phosphuret of copper and the nickel are completely melted, and combined or mixed. The effects produced by this introduction of phosphorus are to augment the fusibility of the alloy, causing it, when melted, to run in a very limpid state, to obtain a closer grain, to avoid all porosity, and to have a greater homogeneity, and finally to render the whiteness greater.

Alloys for Journal Boxes.—The following claim for a new alloy for journal boxes has been patented by Joseph Garrat, Sen., of Indianapolis, Ind.:—"I claim the production of an alloy of a bluish gray color, which, while it has unsurpassable anti-friction qualities, has also sufficient tenacity to allow of journal boxes being formed of it, that do not require the protection of outer casings of a harder metal; the said alloy being composed of zinc, copper, and antimony, in about the following proportions, viz., seventeen parts zinc, one part copper, and one part and a half of antimony, or any other mixture substantially the same, and which will produce the same effect."

"Boxes," says the *Scientific American*, "formed of this alloy, possess inherent strength and hardness sufficient to prevent them being pressed out of form, as is the case with Babbitt metal. The latter has to be encased with brass or some very hard substance. This new alloy causes as little, if not less friction, than brass boxes, or those formed with the Babbitt metal. They are easily worked, receive an excellent polish, and as they can be manufac-

tured much cheaper than common boxes, their use on railroads and every species of machinery, would probably effect an important economy."

ON ALLOYS OF IRON, POTASSIUM, AND ALUMINUM NOT SUBJECT TO OXYDATION.

Professor Calvert at the British Association stated that he had succeeded in preparing the following alloys of iron and aluminum: 1st alloy, 4 equivalents of iron; 1 do. of potassium: 2d alloy, 6 equivalents of iron; 1 do. of potassium. These alloys were prepared with a view of solving one of the great chemical and commercial questions of the day—namely, that of rendering iron less oxydable when exposed to a damp atmosphere; as it is believed that no kind of coating can be discovered which will resist the constant friction of water, as in the case of iron steamers. Professor Calvert has also succeeded in producing two new alloys, composed of iron, combined with that most valuable and extraordinary metal, aluminum. These alloys are composed as follows:—1st, 1 equivalent of aluminum; 5 do. of iron; 2d, 2 equivalents of aluminum; 3 do. of iron. The last alloy presents the useful property of not oxydizing when exposed to a damp atmosphere, although it contains 75 per cent. of iron.

ON THE INDUSTRIAL EMPLOYMENT OF EARTHY METALS.

The great affinity of aluminum for carbon, with which it forms a very stable and exceedingly hard alloy, renders it valuable in the manufacture of steel. It serves to fix the carbon in the metal, so that the same piece of steel may be heated and tempered several times without alteration. Aluminum generally gives steels and alloys of great hardness very white, dull, and damasked. These alloys are ductile and malleable. The alloys of silicium, on the contrary, have a short granular fracture, are of a dull white, without any luster. They are excessively hard but brittle, and become more and more so in proportion as the quantity of silicium is increased. 5 or 6 per cent. of silicium renders metals and alloys capable of being pounded like stones under the pestle.—*Comptes Rendus.*

ON THE ELECTROLYTIC PREPARATION OF THE ALKALINE AND EARTHY METALS, BY DR. MATTHIESSEN.

Induced by Bunsen's experiments upon the alkaline and earthy metals, the author has endeavored to prepare these bodies by electrolysis in Bunsen's laboratory. The treatment of chloride of calcium, chloride of barium, and chloride of strontium, between two large plates of charcoal, presented peculiar difficulties which required to be got rid of. These arise from the circumstance that the metallic granules deposited upon the anode are carried over to the cathode by the currents produced by the evolution of chlorine at the latter. The metals burn at both poles with flames. At the metallic pole oxyd is separated from the protochloride, which becomes basic, from the action of the

moisture of the air; and by this means the current very soon becomes too weak. As Bunsen has found that the decomposition of the chlorides into metal and chlorine depends especially upon the density of the current, particular attention was to be paid to the fulfillment of this condition. By the employment, opposite to the great positive charcoal-pole, of a wire of the thickness of a knitting-needle, the reduction of potassium, sodium, calcium, strontium, etc., took place so easily that the author regards this experiment as one that may hereafter be performed at lectures. It is, however, difficult to obtain the separated metals in large globules. For this purpose the author has suggested the three following methods:

1. The employment of a platinum wire as the positive pole. By this means the metal is alloyed with the platinum.

2. Two chlorides are melted together, in simple atomic proportions, to form a fluid double chloride; the temperature is regulated so that a solid crust is only formed round the negative pole. On cooling, this is found filled with metallic granules.

3. The separation of the metal is affected immediately beneath the surface of the fused chloride, by means of a pole composed of a pointed iron wire. It remains protected by a thin stratum of the fused chloride, which covers it like a varnish, and collects in masses of the size of a mustard-seed.

Calcium.—The method here first described is, it must be confessed, uncertain in its results, but, in favorable cirumstances, it furnishes globules of calcium of the size of peas. A mixture of 2 equivalents of chloride of calcium with 1 equivalent of chloride of strontium and muriate of ammonia is melted in a Hessian crucible until the last-mentioned salt is volatilized; a cylinder of iron, serving as a positive pole, is then immersed in the fused mixture, together with a narrow clay cell of the length of a finger, previously heated to redness and filled with the same fused mixture; this serves for the reception of the negative pole, which consists of a piece of iron wire, or a stick of charcoal of the thickness of a knitting-needle. When the fused chlorides in the clay cell stand from ½ an inch to 1 inch higher than in the crucible, the heat of the charcoal furnace may easily be regulated so that a solid crust shall be formed only in the clay cell; beneath this the separated metal collects, without coming in contact with the clay cell. If the current from 6 charcoal and zinc elements be then allowed to pass through for from half an hour to an hour, a large quantity of reduced calcium is obtained. But in general, by this process, the calcium is found in a pulverulent form diffused through the mixture of chlorides, which violently decomposes water.

The metal is obtained with more certainty, although in smaller fused globules, by putting the mixture into a small porcelain crucible, such as is used for the calcination of precipitates, heating by charcoal or the spirit-lamp, and passing the current through the mixture by a charcoal pole of as large size as possible, and a piece of iron piano-forte wire (No. 6), not more than 2 lines in length, which is united with the negative pole of the battery by means of a stronger wire reaching close to the surface. A small crust is to be formed round the wire at the surface. To collect the small globules deposited on the wire, the latter must be taken out about every three minutes, together with

the small crust. The globules are crushed in a mortar, and the flattened granules are then picked out.

It may also be obtained in very small granules, but with more difficulty, by just touching the surface of the fused mass of chlorides for a minute or two with the tip of the wire, so that the action of the current produces a sort of appearance of fermentation. The globules are rather larger than when the point of the wire is immersed and withdrawn until an electrical flame makes its appearance. By this means an alternate heating and cooling is produced by which the pulverulent metal is fused together.

Properties of Calcium.—The properties of the metal prepared in the above manner are as follows. Some of them have hitherto not been correctly recognized:

It is a pale yellow metal, of the color of bell-metal, or of silver alloyed with gold. Freshly filled spots appear paler and remarkably glittering. Fracture-jagged, becoming granular, it is very ductile, and may be cut, bored, or filed. A piece of the size of a mustard-seed could be beaten out to a leaf of 10 or 15 millims., and then only show a few breaks at the margin. In dry air it remains shining, but soon tarnishes in a moist atmosphere. It melts at a red heat on platinum foil, and then burns with a splendid luster, so that pieces of the quarter the size of a pin's head give a ball of fire of a cubic inch in size. Calcium filings thrown into the flame of a spirit-lamp give beautiful stellate sparks. Dry chlorine has but little action upon it; when heated in chlorine gas, or in vapor of iodine or bromine, it burns with bright incandescence. When thrown upon boiling sulphur, it combines with it, with violent evolution of flame. It combines with vapor of phosphorus, without incandescence, forming phosphuret of calcium. With hot mercury it readily forms a white amalgam. It violently decomposes water, becoming converted into hydrate of lime. Dilute nitric, muriatic, and sulphuric acids facilitate the oxydation. Thin laminæ frequently become ignited under the surface of dilute nitric acid; in concentrated nitric acid it retains its bright surface, and is only attacked at a boiling heat. With distilled water as the exciting fluid, it behaves negatively with potassium and sodium, positively with magnesium. It is not, however, reduced from its chloride by potassium or sodium.—*Liebig's Annalen*, xciii. p. 277.

ON SILICIUM AND TITANIUM. BY H. SAINTE CLAIRE DEVILLE.

Among the compounds of oxygen with simple bodies, there is a group of substances whose analogies are incontestible, and which may be characterized by a single feature in their history. These oxyds, which are not acted upon by chlorine alone, become converted into chlorides when in contact with charcoal, under the influence of a current of chlorine at a moderate temperature. Among them I shall mention those which will be referred to in this note, namely, silica, titanic acid and boracic acid. The radicals of these generally-diffused substances have not yet been studied in all their details, and I now lay before the Academy the result of my researches upon this subject.

When sodium is treated with chloride or fluoride of silicium in a tray placed in a porcelain tube heated to redness, the last traces of the metal may be removed; and all that is then necessary is to wash the residue, in order to obtain silicium with all the characters attributed to it by Berzelius. But if the portions which do not adhere to the tray be selected, put into a crucible, surrounded and covered with pure fused chloride of sodium, and heated to a sufficiently high temperature for the volatilization of the greater part of the alkaline chloride, two kinds of products are obtained, which vary according to the temperature and the nature of the flux. In the first place the graphitoid silicium may be produced: fused silicium is also obtained in the midst of a gangue which resists the action of heat; it is then frequently crystallized.

Crystallized silicium has much resemblance in color with specular iron ore when a little iridescent. Its form can not be exactly measured, the faces of crystals being always curved; but the form presents so close a resemblance to those of the diamond, that this comparison has been made immediately by all the mineralogists to whom I have shown it. In this state silicium cuts glass.

The analysis of the crystals which accompanied the specimen exhibited furnished the following results:—100 silicium gave 205 of silica; calculation requires 209. The small quantity of matter which was wanting also contained silica and iron, but in proportions which might be neglected. Thus silicium, like carbon, beside which it has been placed in the series of metalloids, is capable of assuming three distinct forms:—

1. The silicium of Berzelius, which represents ordinary carbon.
2. Graphitoid silicium, which corresponds with graphite, and is obtained under the same circumstances as artificial graphite.
3. Crystallized silicium, which is the analogue of the diamond.

Silicium, consequently, differs from the metals in every respect.

I also exhibit some fused silicium; which has been extracted from different gangues. I can not, however, state exactly either the temperature, which was very high, employed in this new experiment, or the mode of preparation which is most proper for attaining a certain result. I must observe only that silicium takes up iron, wherever it exists, even in vessels of common porcelain, which it corrodes in a singular manner.* In preparing silicium, it is necessary, therefore, to exhaust every precaution in the purification of the original materials, particularly the sodium; to analyze it, it is put with a few drops of nitric acid into a small crucible of Sevres porcelain, and a very small quantity of pure hydrofluoric acid is added (silicium, when strongly heated, resists the action of hydrofluoric acid and nitromuriatic acid); it should dissolve entirely, and the liquid, when evaporated to dryness, should have no trace of ferruginous matter.

Silicium alloys metals, especially copper, to which it communicates a hard-

* It reacts upon alumina, at least in the presence of bases, furnishing vitreous products which appear to be new, and which I am at present engaged in analyzing. The vessels which I prefer are crucibles of coke, calcined, and immersed while still hot in boiling muriatic acid. After remaining for some time in the acid, and being repeatedly washed, these crucibles are very good.

ness so great that the metal resists the action of the file. This is copper-steel.

Titanium, obtained by exactly similar processes, and calcined in crucibles of alumina, is infusible at a temperature which causes the vaporization of platinum; it resembles very iridescent specular iron ore, and crystallizes in prisms with a square base.—*Comptes Rendus*, April 30th, 1855, p. 1034.

ON THE METAL ALUMINUM.

M. Wöhler having contested the priority of the extraction of the metal aluminum from alumina with M. Deville, the latter has replied in a paper before the French Academy urging that the metal he has obtained by sodium and by using new apparatus, differs essentially in the distinctness of its reactions from the aluminum of M. Wöhler. This difference is due to impurities which can not possibly be removed when the operation is made in platina vases: and he asserts that he has ascertained by minute analysis that the aluminum prepared according to M. Wöhler's method contains soda and the platina: now platina raises the point of fusion of the alloy, and the sodium takes from it its most precious properties: making it subject to the influence of boiling water and the weak acids, while pure aluminum resists them; further imperceptible but pure globules have remained three months in sulphuric acid or weak nitric acid, and have not yet been in the least degree changed, and in boiling nitric acid the dissolution proceeds so slowly that M. Deville was forced to abandon that method of analysis; lastly, if a globule of pure aluminum was dropped on red hot and melted caustic soda, it resisted that energetic agent. The aluminum employed in these experiments (it has been analyzed) was perfectly pure, and it is upon these properties, joined to its inalteration when exposed to the air, that M. Deville grounds his hopes to make it useful. It is also worth attention that while M. Wöhler obtained merely microscopic globules, M. Deville now produces masses of it whose volume is limited only by the quantity of matter employed. He ended this reply by suggesting that other more common metals than aluminum, are perhaps less known than may be thought, and he expressed the hope that when he shall have completed a memoir on the pure metals produced and melted by certain yet secret processes, which he has long been preparing, he shall exhibit some unexpected results. Thus he instanced, cobalt and nickel which possess useful physical properties, such as malleability, ductility, developed to a most extraordinary degree; further they enjoy a tenacity far exceeding that of iron, which hitherto has passed as the most tenacious metal; for according to the experiments made by M. Wertheim on these metals, the weights which determine the rupture of wires of iron, cobalt, and nickel of the same dimensions, are 60 for iron, 115 for cobalt, and 90 for nickel, which shows the tenacity of cobalt double that of iron; besides, nickel and cobalt are worked at the forge with the same facility as iron, are oxydized less easily than iron, and are susceptible of being employed in the same manner as iron.

The following is an abstract of a report presented to the French Academy on the subject of aluminum and its preparation:—

"The thorough working of aluminum by means of the chloride of this metal and sodium, is, by general admission, a great acquisition to science. M. Deville procured chloride of aluminum by causing the chlorine to react on a mixture of alumina and coal-tar, previously calcined. The operation was effected in a gas retort with extraordinary facility and perfection. The result of M. Deville's observations is that the action of the chlorine is procured upon a layer of one, or at most, two decimeters of the mixture, so that the absorption of the gas is always complete. The condensation of chloride of aluminum is effected in a chamber of masonry lined with tiles. This chloride is so compact that it can be seen on the table, of considerable density, and composed of yellow crystals. Very slightly ferruginous, it is purified completely during the process of extracting the aluminum, in which its vapor passes over iron filings heated to 400° C. or thereabout. The sesqui-chloride of iron, as volatile as the chloride of aluminum, is changed by contact with the iron, and becomes comparatively very fixed. The vapor of the chloride of aluminum rising from the apparatus forms colorless and very transparent crystals. Sodium is being prepared the meanwhile in large and small vessels with remarkable facility. Having studied with particular care the influence of temperature on the surfaces exposed to heat, and the activity of the vapor of sodium as it escapes from the apparatus, M. Deville is convinced that, by properly regulating the relation between the heated surfaces and the section of tubes from which the sodium issues, one could procure this metal at a moderately high temperature, about that, perhaps, of the melting point of silver. Already even the cylinders are much less heated than are the vessels used in the manufacture of zinc. The author is now employed in producing sodium in continuous apparatus.

"As to the reaction of the chloride of aluminum upon the sodium, that is done in metallic tubes, the form and management of which are not yet sufficiently scientific. In this particular there is yet something deficient. It will be remarked undoubtedly, that in the details above there is no mention of the very reduced price which Messrs. Dumas and Balard have promised. It appears that, for the present at least, this price is still very high, and very far from being what would be considered the net cost, as stated by us conditionally, of the agents necessary to extract the aluminum. Moreover, M. Dumas has not explained himself formally concerning the price even of the new metal, and he has anticipated too much in this respect. Now, if sodium, which cost lately 1,000 francs a kilogram, should rise 30 francs more, as it requires three times the quantity of that to extract a proportion of aluminum, it will be perceived that this latter article would not be so accessible as they would have it seem, not to mention other particulars which increase the expense. Still there is reason to believe that a factory of aluminum established at Marseilles, turning to account the chlorine of muriatic acid, which is produced in superabundance, and the aluminum of certain deposits in the vicinity, could offer this precious metal at a price sufficiently low to place it shortly among the more common ones.

"Scarcely has aluminum been ranked among metals before, independently of the unexpected service it will render as such to the arts and sciences, it

begins to figure as an electro-chemical agent in a no less remarkable manner. The director of the galvano-plastic department of the Mint, M. Hulot, submitted to the Academy, through M. Dumas, some assays in which this metal was substituted for platina as an electro-negative element in the piles to a single liquid. M. Hulot has succeeded, not without great difficulty, in rolling perfectly and without loss, an ingot of aluminum of thirty and some gram's, procured from one of the first meltings of this metal obtained by M. Rousseau—less white than at first, and containing traces of iron and silicium. A connection of aluminum and zinc amalgamated for a long time, charged with water acidulated with a twentieth of sulphuric acid at 66°, disengaged during the first hours considerable hydrogen, and produced a current equal, if not superior, to that of a connection of platina and zinc excited to the same degree. The author asserts that the next day the electro-motive force of the pile was reduced nearly one quarter; but he remarks that it suffices to immerge the aluminum in nitric acid, or still better, as it appears, in sulphuric acid—as it is expedient to effect it at once—to give to the circle its first force.

"As aluminum is nine times lighter than platina, and presents also a surface nine times more extended than the latter metal, with an equal thickness, its substitution for platina should be productive of real advantages, above all now that its price has become very accessible. The aluminum here spoken of is very difficult to forge. In order to roll it, it has been found necessary to anneal it at each pass. By deposing copper electro-chemically on a plate of aluminum, they have succeeded, by the aid of rollers, in reducing it to very thin plates. Hard aluminum acquires by annealing an inflexibility which would make it of great use in the suspension of all kinds of scales for assays or analyses. This metal is so light that, the weights of the system being the same, the arms of the beam can be elongated a great deal, and long blades can be placed even on the extreme points of suspension, as on the center of oscillation. The author does not doubt that in weighing 20 grammes, the sensibility of the balance would not rise a half-millionth."

The price of aluminum a short time since in France was about the rate of gold. M. Dumas, in a recent communication to the Academy, stated that, owing to recent discoveries reducing the expense of extracting it, the cost of production was now about one hundred times less; and M. Balard, another member, stated that there was little doubt that the effect of competition in its manufacture, together with the advantage of throwing it open to the industrial resources of the world, would be to reduce the price as low as five francs the kilogram, or about forty cents a pound.

This important result is mainly attributable to the facility with which we are now able to procure pure sodium in abundance, which is the active agent for the revivication of aluminum, and which was at one time very expensive. M. Dumas observes that the generalization of the procedure of M. Deville, the application of chlorine to the extraction of metals, forms a new era in metallurgy. Among the many remarkable qualities of aluminum, such as its resistance to oxydation, either in the air or by acids, its hardness, its wonderful lightness, its malleableness, the facility of molding it, etc., M. Dumas mentions another, its sonority. An ingot was suspended by a string, and being lightly

struck, emitted the finest tones, such as are obtained only by a combination of the best metals.

PREPARATION OF METALLIC LITHIUM.

Bunsen has continued his observations on the alkaline and earthy metals, and has succeeded in isolating lithium upon a sufficiently large scale to admit of an accurate determination of its chemical and physical properties. Lithium is more easily prepared than the other metals belonging to the same class, and its separation forms an easy and certain lecture-room experiment. Chloride of lithium is to be fused in a small thick porcelain crucible over a Berzelius lamp, and decomposed by a current of from 4 to 6 Bunsen's elements. The current passes from a point of gas-carbon through the fused chloride to an iron wire as thick as a knitting-needle. After a few seconds a small silver white regulus forms and adheres to the wire, gaining in a few minutes the size of a small pea. The mass is to be removed from the fused chloride by passing under it a small iron spoon, and withdrawing the spoon and the wire electrode together so that the metal shall remain covered with a varnish of the fused chloride. The spoon is then to be cooled under naptha, and the metal scraped off with a penknife. As these operations may be repeated every three minutes, an ounce of chloride of lithium may be reduced in a short time. Lithium is a white metal having the color of silver, but a freshly cut surface soon becomes yellowish from oxydation. Fused at 180, and quickly pressed up between two glass surfaces, lithium gives a mirror which perfectly resembles polished silver in color and luster. Its streak is gray, while that of calcium, barium, or strontium is yellow. Lithium is also a very tough metal, and can easily be drawn to a wire like lead, but its tenacity is much less than that of the latter metal. Lithium fuses at 180°, is not volatile at a red heat, and can be welded at ordinary temperatures. Its density is 0.5936, and it is the lightest of all solid bodies. If we take its equivalent at 81.7 (0=100) its atomic volume is 137. It is less oxydizable than potassium or sodium—takes fire at a temperature far above 180° Centigrade, and burns quietly without sparks, and with a white and unusually dense light. The elevation of temperature is here so great that a piece of lithium weighing only 0.005 qr. will melt a hole of 36 millimeters in a piece of mica, upon which it moves with a serpentine motion. Strontium and calcium burn in a similar manner—with a yellowish light, however, and not so quietly, but with sparks and a hissing noise. Lithium burns in oxygen, chlorine, bromine, carbonic acid, vapor of iodine, and upon fused sulphur, like calcium and strontium, with extraordinary brilliancy and intense white light. Upon water lithium floats and oxydizes like sodium, but without fusing. Silica glass and porcelain are reduced by lithium under 200° Centigrade, but by calcium and strontium only at a red-heat. Calcium and strontium are not white metals, as has been stated, but show under the polishing steel, as well as when reduced to a red-heat and freshly cut, a beautiful gold yellow color.—*Ann. der Chemie und Pharmacie*, 1855, xciv.

ELECTRO-PLATING WITH THE WHITE METALS.

Aluminum and Silicium obtained from Clay, Stone, and Sand.—In the *Annual of Scientific Discovery* for 1855, pp. 235, 236, some account was given of the experiments of Dr. Gore, of Birmingham, England, whereby he was enabled to effect an electro-plate of the white metals aluminum and silicium, from the compounds of their oxyds, clay, sand, etc. As this subject is one of no little importance, we give in the following article the experiments of Dr. Gore somewhat in detail.

To coat articles of copper, brass, or German silver with aluminum, take equal measures of sulphuric acid and water, or take one measure each of sulphuric and hydrochloric acids, and two measures of water; add to the water a small quantity of pipe-clay, in the proportion of five or ten grains by weight to every ounce by measure of water (or one half ounce to the pint), rub the clay with the water until the two are perfectly mixed, then add the acid to the clay solution, and boil the mixture in a covered glass vessel one hour. Allow the liquid to settle, take the clear supernatant solution, while hot, and immerse in it an earthen porous cell, containing a mixture of one measure of sulphuric acid and ten measures of water, together with a rod or plate of amalgamated zinc; take a small Smee's battery, of three or four pairs of plates, connected together intensity fashion, and connect its positive pole by a wire with the piece of zinc in the porous cell. Having perfectly cleaned the surface of the article to be coated, connect it by a wire to the negative pole of the battery, and immerse it in the hot clay solution; immediately abundance of gas will be evolved from the whole of the immersed surface of the article, and in a few minutes, if the size of the article is adapted to the quantity of the current of electricity passing through it, a fine white deposit of aluminum will appear all over its surface. It may then be taken out, washed quickly in clean water, and wiped dry and polished; but if a thicker coating is required, it must be taken out when the deposit becomes dull in appearance, washed, dried, polished, and reimmersed; and this must be repeated at intervals, as often as it becomes dull, until the required thickness is obtained. With small articles it is not absolutely necessary, either in this or the following process, that a separate battery be employed, as the article to be coated may be connected by a wire with the piece of zinc in the porous cell, and immersed in the outer liquid, when it will receive a deposit, but more slowly than when a battery is employed.

To coat articles with silicium, take the following proportions: three quarters of an ounce, by measure, of hydrofluoric acid, a quarter of an ounce of hydrochloric acid, and forty or fifty grains either of precipitated silica, or of fine white sand (the former dissolves most freely), and boil the whole together a few minutes, until no more silica is dissolved. Use this solution exactly in the same manner as the clay solution, and a fine, white deposit of metallic silicium will be obtained, provided the size of the article is adapted to the quantity of the electric current. Common red sand, or indeed any kind of silicious stone, finely powdered, may be used in place of the white

sand, and with equal success, if it be previously boiled in hydrochloric acid to remove the red oxyd of iron, or other impurities.

Both in depositing aluminum and silicium, it is necessary to well saturate the acids with the solid ingredients by boiling, otherwise very little deposit of metal will be obtained.

Among the many experiments I have made upon the subject, the following are a few of the most interesting:—Experiment 1. Boiled some pipe-clay in caustic potash and water; poured the clear part of the solution into a glass vessel, and immersed in it a small earthen porous cell containing dilute sulphuric acid and a piece of amalgamated zinc; immersed a similar piece of bright sheet copper in the alkaline liquid, and connected it with the negative pole of a small Smee's battery of three pairs of plates; connected the zinc plate with the positive pole, and let the whole stand undisturbed all night. On examining it next morning, I found the piece of copper coated with a white silver-like deposit of metallic aluminum. Experiment 2. Boiled a mass of red sand rock in hydrochloric acid to remove the red oxyd of iron, washed it clean with water, and dissolved it by boiling in a mixture of hydrofluoric acid, nitric acid, and water; immersed in this solution a porous cell with dilute acid and zinc, as before; connected a piece of brass to the zinc by a wire, and suspended it in the outer liquid, which was kept hot by means of a small spirit lamp beneath. After allowing the action to proceed several hours, I found the piece of brass beautifully coated with white metallic silicium. Experiment 3. Took one part, by weight, of the same sand-stone, after being purified by the hydrochloric acid, and $2\frac{1}{4}$ parts of carbonate of potash, fused them together in a crucible until all evolution of gas ceased, and a perfect glass was formed; poured out the melted glass, and when cold, dissolved it in water; used this solution in the same manner as the former ones; allowing the action to proceed about twelve hours, when a good white deposit of metallic silicium was obtained. Experiment 4. Took some stones with which the streets of Birmingham are Macadamized; pounded them fine in a mortar; boiled the powder in hydrochloric acid, to purify it from iron; washed it well in water, and dissolved it by boiling an excess of it in a mixture of $\frac{3}{4}$ oz., by measure, of hydrofluoric acid, $\frac{1}{2}$ oz. of this solution in the same manner as the former liquids, and readily coated in it a piece of brass with a beautifully white deposit either of aluminum or silicium.

From these and many other experiments which I have tried, it is quite clear that common metal articles may be readily coated with white metals, possessing similar characters to silver, from solutions of the most common and abundant materials, and thus bring within the purchase of the poorer classes articles of taste and cleanliness, which are at present only to be obtained by the comparatively wealthy.

BRASS FORMED BY GALVANIC AGENCY.

Copper is more electro-negative than zinc, and separates more easily from its solution than a metal less negative. If, then, in order to obtain a deposit of brass by galvanic means, we employ a solution containing the two com-

ponent metals, copper and zinc, in the proportions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper; the zinc, more difficult of reduction, remains in solution. What must be done, then, to obtain a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or accelerate that of the zinc. This may be done by forming the bath with a great excess of zinc, and very little copper. Dr. Heeren gives the following proportions as having perfectly succeeded:—"There are to be taken of the sulphate of copper 1 part; warm water 4 parts; and then sulphate of zinc 8 parts; warm water 16 parts; cyanide of potassium 18 parts; warm water 36 parts.

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; and therefore a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium; indeed it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements, charged with concentrated nitric acid, mixed with one tenth of oil of vitriol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot; after a few minutes there is produced a layer of brass, the thickness of which augments rapidly. Deposits of brass have been obtained in this way on copper, zinc, brass, and Britannia metal; these metals were previously well pickled. Iron may, probably, also be coated in this way; but cast iron is but ill adapted for this operation.—*London Mining Journal.*

NEW PROCESS FOR ELECTRO-GILDING.

A new process for electro-gilding has been proposed by M. Briant, and favorably reported on by the Academy of Sciences at St. Petersburg. It consists essentially in the substitution of the oxyd for the chloride of gold in the preparation of the gilding bath, and in the employment of a very feeble current from a constant or sustaining battery. 802,88 grains of gold are to be dissolved in nitric muriatic acid, and the solution evaporated, for the purpose of obtaining the chloride of gold dry, and as free as possible from acid. The chloride is then dissolved in 11 pounds of hot water, and 1,544 grains of well-sifted magnesia added, and allowed to digest at a moderate temperature. The oxyd of gold, when separated, is found in combination with the magnesia. The magnesia, well washed, is then treated with water acidulated with nitric acid, in the proportion of 3,759 grains of acid to 5 kilograms of water. The magnesia is dissolved by the acid, leaving the simple hydrated oxyd of gold, which is now thrown upon a filter and washed till quite free of acid.

It is with this oxyd of gold thus prepared that M. Briant proposes to form his bath. He takes of yellow prussiate of potash 500 grains; of caustic potash 120 grains; water 5 kilograms. To this solution the oxyd of gold with

the filter is added, and the whole boiled for twenty minutes. The oxyd of gold dissolves, and there is formed at the same time a precipitate of sesquioxyd of iron. It is allowed to cool, and is then filtered, by which a yellow liquid fit for use is obtained. The objects to be gilded should be well cleaned, and attached to the negative pole of an element of Daniell's battery, while a plate of platinum is attached to the positive pole. The gilding may be effected either in a warm or cold solution; in the first case a deposit forms more rapidly, but with less delicacy. In order to obtain a durable deposit, analogous to fire gilding, several hours are required. When the liquid is exhausted of its gold, fresh oxyd is added, by which a further precipitation of oxyd of iron is produced. The gilding obtained by this process admits of being burnished, and of undergoing all the operations employed to produce *mat*, or dead gold.

One of the most difficult problems to solve in this branch of manufacture is the production of dead surfaces. Its production in the ordinary way is always accompanied with a loss of metal, inasmuch as it necessitates a system of corrosion of the surface by chlorine. By Briant's process a matted surface can be obtained by galvanic agency not inferior to the best of Paris, while it does not require any of the subsequent operations required in fire gilding. The mat appearance is spontaneously produced as soon as the coating of gold has acquired a certain thickness; it is most beautiful when the operation is carried on in the cold. By a very simple artifice a more or less reddish tint, on the one hand, or a whitish one on the other, is produced; it is merely required to dilute the bath with more or less water. When the objects to be gilded are polished or brilliant, the electro-gilding will also be brilliant, and it requires a longer time and a thicker coating of gold to produce a deadened surface. It is therefore important to communicate, in the first instance, a deadened surface to the objects by the process employed in fire-gilding; or, more economically, by covering them at once with a thin pellicle of copper by the electric agency, which, as is well known, produces a beautiful matted surface. When any part of the object is to be protected from the action of the gilding process, the choice of the substance to be used in "stopping out" these parts is of importance, for it must be remembered that the bath is alkaline; for this purpose plaster, impregnated with an alcoholic solution of lac is recommended. —*Bulletin Société d'Encouragement.*

ARTIFICIAL PRODUCTION OF SILICATES AND ALUMINATES.

By bringing chloride of silicium and other volatile chlorides in contact with lime and other bases at a red heat, decomposition occurs, and silicic acid is produced and is deposited in crystals, either alone or in combination with the bases present. By means of lime, magnesia, alumina or glucina, and chloride of silicium, crystallized quartz is obtained in its usual form, and part of the base is converted into a silicate. With lime Wollastonite (table spar) is obtained in rhombic tables, with two faces replacing the obtuse angles, exactly as in the natural crystals. These tables are frequently united in the form of a cross, like the crystals of staurotite. By means of magnesia, peridote is obtained, in rectangular prisms. Alumina gives a silicate in long prisms with an oblique

base, which is not attacked by acids, is infusible, and has all the properties of kyanite. It is interesting to observe that in this reaction chloride of aluminum is produced at the cost of the silicium.

In order to produce a double silicate, it is not enough to mix with two bases in the requisite quantity, but there must be an excess of one of them in order to supply the requisite amount of oxygen to the silicon. In this way a mixture of lime and magnesia yields colorless and transparent crystals of augite (diopside). By a mixture of seven equivalents of potash or soda, and one of alumina, or one of alkali, one of alumina, and six of lime, crystals of the form and characters of feldspar are obtained. By using different bases, and modifying their proportions, crystallized Willemite (silicate of zinc), idocrase, garnet, phenakite, emerald, euclase, and zircon are obtained. By making a mixture corresponding to the constituents of magnesia, tourmaline and iron, and magnesia tourmaline, adding excess of lime or magnesia, and exposing the whole to the chloride of silicium, in addition to rock crystal, very distinct hexagonal prisms with all the properties of tourmaline were obtained. By passing chloride of aluminum over red-hot lime, crystals of alumina, corresponding to the two well-known forms of corundums, were obtained. When magnesia is used, the silicic acid unites with the excess, and crystals of spinelle are produced. A mixture of chloride of zinc and aluminum, brought in contact with lime, produces gahnite. Chloride of titanium, acting on lime, produces titanic acid in the form of Brookite. Chloride of tin gives the crystallized oxyd. Chloride of iron gives specular iron ore, and if mixed with chloride of zinc, Franklinite is produced. Chloride of magnesium gives crystallized magnesia, exactly similar to the periclase of Monte Somma.

The result of these experiments lead to many interesting conclusions. They show us how such minerals as augite, garnet, epidote, axinite, and many others, which certainly can not have been produced by fusion, may be formed. Indeed, the production of a large number of minerals may, with great probability, be attributed to the action of volatile chlorides and fluorides, and the penetration of those into the fissures of limestone; and the very powerful action of lime on these compounds may explain the abundance of silicates which exist disseminated through many limestones. Minerals, such as spinelle, chondrodite, mica, augite, amphibole, serpentine, etc., are frequently found in limestones which contain no magnesia, and this hitherto unexplained fact may be due to the difference in the chemical affinities of lime and magnesia; for it is observable that in all these experiments chloride of magnesium is decomposed by them. Many other obscure facts may also be explained by reference to these researches, which are of very great mineralogical interest.—*M. Daubree. Comptes Rendus*, v. xxxix, p. 135.

ON THE ELECTRO-CHEMICAL EXTRACTION OF METALS FROM THE HUMAN ORGANISM.

During the past year great success has attended the workings of a plan devised by M.M. Vergnes and Poey, for extracting metallic compounds from the human system by means of chemico-electricity. The arrangement of the

bath is as follows:—The patient is plunged to the neck into a metallic bath isolated from the ground, and is seated with the legs horizontal on a wooden bench of the whole length of the body, which is also isolated from the bath. The water is acidulated with nitric or hydrochloric acid for the extraction of mercury, silver, or gold, and with sulphuric acid for lead. The patient being in the bath, one end of the bath is put in contact with the negative pole of the battery by means of a binding screw, and he is made to take the positive pole sometimes in the right and sometimes in the left hand. The arm is sustained by means of supports in connection with the bench. The patient being thus placed, the current enters the body, circulates from the head to the foot, and is neutralized on the sides of the bath at the negative pole. Being isolated from direct contact with the negative pole, his body radiates in the bath the electricity which forms in it, a multitude of currents issuing from the entire surface, after having traversed the internal organs, and even the bones, to be neutralized on the negative side of the bath.

ON THE ELECTRO-CHEMICAL TREATMENT OF ORES OF SILVER, LEAD, AND COPPER, BY M. BECQUEREL.

This electro-chemical process consists in preparing the ores in such a manner that the resulting compounds of silver and lead (in operating upon galena) may be soluble in a saturated solution of common salt; these compounds are chloride of silver and sulphate of lead. When the solution is made it is put into a wooden reservoir, when the decomposition of the metallic salts is effected with couples formed of plates of zinc and tinned iron, or copper, of masses of calcined charcoal, or even of plates of lead and the same negative elements. The plates of zinc or lead are placed in bays of sail-cloth filled with a saturated solution of salt, which are immersed in the metallic solution; the other plates are put into the latter, and the communication established between them by means of wires. With plates of zinc a deposit of very fine particles of all the reducible metals is obtained on the negative plates. With lead plates the deposit consists of silver in greater or less purity, according to the proportion of lead in the solution. Wooden boxes, steamed for the removal of all extractive substances, are better than the sail-cloth bays; or porous earthen vessels may be employed, filled with fragments of amalgamated zinc and mercury. The action is then more regular, and the quantity of zinc consumed is in atomic proportion with that of the deposited metals. By varying the constitution of the voltaic couples, each of the metals contained in the solution may be successively separated.

This process has been tried on a large scale, and is stated to be especially applicable to the working of silver ores, not only in the case of the positive want of mercury, but even when the price of that metal becomes rather high. —*Abridged from the Comptes Rendus, June*, p. 1095, *Chemical Gazette, No.* 286.

NEW PROCESS FOR THE DETERMINATION OF COPPER IN MINERALS AND ARTIFICIAL PRODUCTS, BY M. RIVOT.

The author having found that all the principal processes for the determination of copper in minerals and alloys were liable to error, has adopted a new method, which is founded on the insolubility of the sulpho-cyanide of copper $Cy\ S^2\ Cu^2$, and the great solubility of the sulpho-cyanides of all the other metals in acid fluids. It consists in the three following operations:—

1. All the metals contained in the substance under examination are dissolved in hydrochloric acid, avoiding the use of oxydating agents.

2. The salt of copper is brought to a minimum by means of a reducing agent (hypo-phosphorous or sulphurous acid), and a dilute solution of sulpho-cyanide of potassium is poured into it; this immediately precipitates the copper alone.

3. The metal is determined by drying the sulpho-cyanide thus obtained at a moderate heat. The determination may be checked by converting the sulpho-cyanide into sulphuret of copper by fusion with a little sulphur in a porcelain crucible, from which the air must be excluded.

This process may be simplified when the substance to be examined contains no metals (besides copper) precipitated by sulphuretted hydrogen. In this case the solution of all the metals is affected by muriatic acid, and the copper precipitated by sulphuretted hydrogen. The precipitate is converted into sulphuret of copper by fusion with a little sulphur.—*Comptes Rendus*, p. 865, 1854.

SEPARATION OF COBALT FROM NICKEL.

Liebig has found that when a current of chlorine is passed into a cold solution of the double cyanides of cobalt and potassium and of nickel and potassium, the liquid being kept alkaline by the addition of caustic soda or potash, the nickel is completely converted into sesqui-oxyd and precipitated, while the cobalt remains in solution as unaltered double cyanid. The sesqui-oxyd of nickel may be washed and ignited, and the nickel weighed in the form of protoxyd; it is perfectly free from cobalt. The solution, after passing the chlorine, must still be alkaline. The smallest trace of nickel gives an inky black color when dissolved in cyanid of potassium, and treated with chlorine. This method of separating cobalt and nickel has, perhaps, some advantages over Liebig's second method, which, it will be remembered, consists in boiling double cyanids with oxyd of mercury, which precipitates the nickel but not the cobalt.

IODO-NITRATE OF SILVER.

This substance, the active principle in the collodion photographic process, has been found to be a definite compound of the iodide and the nitrate of silver, its composition being represented by $Ag\ O,\ NO^5 + Ag\ I$; it is blackened on exposure to light much more rapidly than either of its ingredients alone. It is unaffected by and insoluble in absolute alcohol, but is decom-

posed by water. Its proper solvent is a concentrated solution of nitrate of silver. It may be obtained in regular crystals. Photographic silver baths which have been for some time in use always contain a portion of this compound, the reason of their superiority to those more recently prepared. Chloride and bromide of silver do not yield similar double salts, which explains why negative photographs on bromide of silver alone are deficient in intensity.

SPONGY METALS.

M. Chenot has often remarked that in compressing spongy iron, the production of a harsh sound accompanied the rupture of the molds employed. Very recently, in compressing spongy silicium, this fact was reproduced in a very marked manner. Three gram's of silicium in the spongy state having been submitted to a pressure equal to 300 atmospheres, it exploded with a fearful noise—the fragments of steel from the broken matrix entered many millimeters into a plate of cast iron, and the body of the hydraulic press, which was 20 centimeters in thickness, was broken, and this although the safety valve was open, thus showing the sudden violence of the shock. The action was entirely from above, downward, since no portion of the upper part of the compressed metal in this case suffered.

ON THE DETECTION OF MANGANESE.

The following paper has been read before the Royal (English) Society by Edmund Davy, Esq.:

Manganese is chiefly found combined with oxygen, but its oxyds are commonly mixed with those of iron, and though different methods of separating them have been recommended, yet no very simple or unobjectionable test for manganese seems to be known. Two methods for detecting manganese are recommended—viz., 1. The pure hydrated fixed alkalies, potash and soda, and especially potash. 2. Sulphur. With regard to the first method. Though the compound *chameleon mineral*, made by strongly heating niter or potash and peroxide of manganese together, has long been known, yet it appears hitherto to have escaped observation that potash seems to be a more delicate test of manganese than any other known substance. The use of potash in this way is simple and easy; it is employed in solution; equal weights of the alkali and water form a fluid well adapted for the purpose; different metals may be used in the form of slips on which to make experiments, but a preference is given to silver foil, as it is less acted on by alkalies than platina, and is more readily cleaned. A slip of such foil, about two or three inches in length and half an inch wide, answers well. Solids, to be examined for manganese, are finely pulverized; fluids require no preparation; the smallest portion of ether is mixed with a drop or part of a drop of the alkali on the foil and heated by a spirit-lamp (for many experiments a candle affords sufficient heat), when on boiling the alkali to dryness and raising the heat, the characteristic green manganate of potash will appear on the foil. The delicacy of the alkali as a test thus applied will be obvious on using the most minute por-

tions of manganese ores in fine powder, and the author's son, Dr. E. W. Davy, readily detected manganese in a single drop of a solution containg one grain of solid sulphate in ten thousand grains of water. The presence of other oxyds does not appear to impair the efficacy of this test. A strong solution of hydrate of soda in water, used in a similar manner, affords an excellent test for manganese, little inferior in delicacy to potash, but the latter is shown to be preferable. Carbonate of soda has long been regarded as one of the most delicate tests of manganese, especially if aided by a little nitrate or chlorate of potash; but that carbonate is much inferior as a test for manganese to potash or soda, requiring a far higher temperature to form the manganate of soda, and the aid of oxydizing substances, as niter and chlorate of potash, which are quite unnecessary with those alkalies. Borax, too, in point of delicacy is not to be compared with the fixed alkalies as a test for manganese. The author is of opinion that the fixed alkalies in solution and silver foil will form a valuable addition to the agents employed by the mineralogist and chemist in the examination of minerals, ores, &c. 2. *Sulphur.*—If a little flower of sulphur be mixed with about its own bulk of the common peroxide of manganese, and exposed on a slip of platina foil to a red heat, sesquioxyd, sulphuret, and sulphate of manganese will be formed, and by continuing the heat for a short time, an additional quantity of the sulphate will be produced from the sulphuret. On treating the mass with water and filtering the fluid, a solution of sulphate of manganese will be obtained, which will yield a white precipitate with the ferro-cyanide of potassium, without a trace of iron. Similar experiments may be made with any manganese ores, or with substances known or suspected to contain manganese. The quantity of materials operated on may be increased or diminished at pleasure; but if increased, the heat should be continued a little longer, to decompose any remaining sulphuret, and thus add to the quantity of sulphate formed. In the same way manganese was detected in some minerals in which it was known to exist, and in others in which it had not been previously found; likewise in soils and subsoils, in the ashes of coal and peat, in a number of pigments, and also in the ashes of different fabrics partially dyed brown by manganese. Sulphate of manganese is formed, with sulphuret, when sulphurous acid gas is made by heating a mixture of peroxide of manganese and flowers of sulphur, even in close vessels. The sulphate may also be more readily obtained, in quantity, by simply boiling a solution of common green vitriol in water for about a quarter of an hour or upward, in contact with an excess of sesquioxide of manganese in fine powder, till the solution affords a white precipitate with ferrocyanide of potassium. Chloride of manganese may also be formed in a similar manner by boiling an aqueous solution of protochloride of iron with an excess of sesquioxyd, or it may be made with greater facility by dissolving this oxyd in the common muriatic acid of commerce, taking care that the oxyd be present in excess. The brown sesquioxyd of magnesia may be made, not only by means of sulphur, but more readily and better by mixing the common peroxyd with about one third of its weight of peat-mold, sawdust, or starch, and exposure to a red heat in an open crucible, with occasional stirring for about a quarter of an hour, or until the oxyd acquires a

uniform brown color. The sulphate and chloride of manganese being extensively used in dyeing, calico-printing, and other arts, and in making the compounds of manganese, the simple means stated of forming those salts, free from iron (it is presumed), are material improvements on the circuitous methods hitherto adopted.

ON THE MANUFACTURE OF STEEL.

In a recent communication to the Boston Society of Natural History, on the manufacture of steel, Dr. C. T. Jackson stated, that when iron is mingled with a considerable proportion of manganese, a brittle compound results; but when combined with a very small proportion of manganese, a steel of very fine quality is obtained, which has this advantage over carbon steel: carbon steel becomes coarse when tempered in thick masses, from segregation of the particles of carbon, but no such trouble arises with manganesian steel. Parties in England have lately introduced excellent wire for piano-forte strings, made of this kind of steel, as well as for cutting instruments and other purposes. In the wire Dr. Jackson has found 1-12 per cent. of manganese, and has established the fact that it resists, to a very remarkable degree, the action of hydrochloric acid. Sixteen years since Franklinite iron was manufactured by Mr. Osborn into very hard and fine steel. This steel required tempering at a lower heat than carbon steel. Many of our manganesian irons might be manufactured into steel by the simple process of fusion, and a steel of uniform character might be made without previous cementation with carbon. Manganesian iron ore is reduced to pure iron, or "comes to nature," in the language of the workmen, with much greater rapidity than carbon iron; hence the two metals are often mixed to "come to nature" at a good time, requiring less care and watchfulness on the part of the workmen. Manganesian iron makes the best bar iron.

RUNDLE'S METHOD OF SEPARATING GOLD.

In a letter to the *London Mining Journal*, J. H. Rundle of the Colonial Gold Works, at Rotherhithe, states that mercury, in the separation of gold from auriferous sands, unites with it in varying quantities. The quantity of gold absorbed by mercury depends, he says, on the following conditions: first, the more or less finely divided state of gold in the ore; second, the length of time during which the mercury remains in contact with it; third, the temperature at which the amalgamation is conducted; fourth, the presence of other metals in the amalgam.

The following method of separating gold from mercury, when the latter by assay is found too rich, is employed: The mercury, after being strained, is assayed; granulated zinc, previously cleaned with dilute sulphuric acid, is then added to it. As soon as the zinc is completely amalgamated, which takes place in a few hours, the mercury is well stirred and restrained; a solid amalgam is obtained, containing, practically speaking, the whole of the gold, and the greater part of the zinc which has been added. The proportion of

zinc necessary is about $\frac{1}{3}$ of the weight of the gold to be extracted, that is, an equivalent of zinc to one of gold. With less the whole of the gold is not obtained. If more than an equivalent be employed, the mercury retains a considerable quantity of zinc; the difficulty of refining gold is also increased. When the object is to extract all the gold, it is advisable to use a small excess of zinc, as there are generally traces of other metals in the mercury which interferes with the uniformity of the results.

IMPROVEMENTS IN PUDDLING IRON.

The following improvements in puddling iron have been patented in England, by James Nasmyth, the well-known inventor. The improvements consist in the disengagement of the carbon from the molten metal in the puddling-furnace, by subjecting it to the action of currents of steam, introduced as near as possible at the lowest portion of the molten metal; thence diffused upward so as not only to mechanically agitate the metal, and thereby expose fresh surfaces to the action of the oxygen of the air passing through the furnace, but also to remove the sulphur and other deleterious substances in the iron, by thus making the oxygen of the air, and also the hydrogen of the water, combine with and carry them off in the state of gas. It is stated that this process shortens the period of puddling, and greatly improves the character of the iron, rendering it tough and strong to a remarkable degree. The steam is introduced by a pipe under the molten metal, and the supply of it shut off, when, in the judgment of the operative puddler, the metal has been sufficiently decarbonized. The patentee states that water may be forced under the surface of the metal to produce the same effects; but this would cause explosions; small quantities, however, he says, would be equivalent to steam. The steam is not used for about five minutes after the metal is melted. Care must be exercised not to use it too long, or the oxygen of the steam will unite with the iron and form an oxyd.

IMPROVEMENTS IN THE MANUFACTURE OF TYPE.

An English patent has been granted to J. R. Johnson for improvements in the manufacture of type, which consist in employing tin in the place of lead, mixed with antimony. The advantage gained is, that the type produced is so hard, tough, and enduring, that they allow of being used as a punch on the ordinary type-metal. Type so prepared preserve their faces sharp for a great length of time, and in the end prove more economical than the cheaper alloy of lead and antimony. The proportions used by the patentee are 75 parts of tin to 25 of antimony, but this may be to some extent varied. When lead is also used, it must not exceed 50 parts in 100 of the combined metals employed; for if the lead be employed in much larger quantity an alloy is formed which approaches ordinary type-metal in properties, notwithstanding the presence of a large per centage of tin.—*Chemical Gazette, May* 1, 1855.

Another composition for type-metal has been recently patented in Bavaria. The principal constituent is zinc to which the requisite properties are given

by the addition of tin, lead, and copper. The following proportions are recommended: 89 to 93 parts of zinc, 3 to 6 parts of tin, 2 to 4 parts of lead, and 2 to 4 parts of copper.

DETECTION OF PHOSPHORIC ACID IN ROCKS.

The solution of phosphate of lime in fused chlorides of sodium, and its separation on cooling, furnish an excellent means of detecting minute quantities of phosphoric acid in rocks, etc. For this purpose the powdered substance is heated with 50 per cent. of chloride of sodium, which, when the substance is tolerably fusible, separates from the silicates as an upper layer. When the substance is not fusible, the chloride of sodium remains partially mixed with it, in cavities distributed throughout the mass, and presenting after the solution of the chloride a remarkable similarity to the vesicular cavities of amygdaloid. The small crystals of apatite generally project like hairs from the surfaces of the partially dissolved mass, and being soluble in very dilute hydrochloric or nitric acid, they may be collected by that means and estimated. The author has in this way detected phosphoric acid in greenstone belonging to the primitive and transition formations of Scotland: in the greenstone occurring as boulders in the more recent formations; in that of the trap formation of Greenland; in the basalt of Steinheim; in a coarse granular basalt or lava from Iceland; in three varieties of gneiss and granite from Bornholm, and in two varieties of mica schist. From one Bornholm granite, remarkably fine and distinct crystals of apatite were obtained. The observation made some years ago by Fownes of the presence of phosphoric acid in rocks thus gains further confirmation, in addition to the testimony of Swanberg and Struves.—*Correspondent Edinburg Journal.*

ACTION OF WATER AND AIR ON BASALT.

Bensch having ground a quantity of basalt to a fine powder with water on a porphyry slab, left it for some months in a beaker glass, covered with paper. At the end of that time it was found to have been converted into a mass so hard as to require a smart blow of a hammer to break it. Its fracture was similar to that of the natural basalt, and the interior consisted of a black core, having a waxy luster, and surrounded by a less compact gray mass. By longer exposure to the air, an efflorescence of carbonate of potash appeared on the surface, and 1·8 per cent. was extracted by water. The specific gravity of the basalt was 2·887, and after extraction of the carbonate of potash, the internal portion of the altered basalt had a specific gravity of 2·1588; that of the external portion was 2·0423. There is no doubt that a hydrate must have been formed in this case, and the observation may serve to throw some light on the changes which take place in the weathering of rocks. —*Annalen der Chimie und Pharmacie*, v. xci., p. 234.

SEPARATION OF BROMINE FROM IODINE.

Balard's process gives a method of recognizing traces of iodine, and at the same time separating it from bromine, with which it is so often associated.

It is based partially on the greater affinity of bromine for the metals, and partially on the violet color which iodine communicates to the sulphuret of carbon. The matter is treated with potash (or carbonate of potash, which may be more easily obtained pure and free from chlorine); it is evaporated and calcined to transform the bromate into bromid; it is then neutralized by means of an acid; the liquid is put into a test tube, and a drop of sulphuret of carbon is introduced, after which a drop or two of bromine, dissolved in distilled water, is added; it is then agitated, and if there is iodine present, the sulphuret of cobalt is colored violet. It is colored yellow by bromine. It is important to avoid an excess of bromine, lest it form a bromid of iodine, which does not act. I have tried the process, and found it exact nearly to a tenth of a milligram of iodine.—*Nickles's Correspondence*, *Silliman's Journal.*

ISOLATION OF FLUORINE.

M. Fremy, of France, has continued his investigations during the past year on the isolation of fluorine. By causing a powerful galvanic current to act upon fused fluoride of potassium, an odorous gas was generated, which, on disengagement from the mouth of the retort, decomposed water, producing hydrofluoric acid. This gas, there is every reason to believe, was fluorine.

FLUORINE IN THE SCALES OF FISHES.

At a recent meeting of the Boston Society of Natural History, Dr. C. T. Jackson communicated some chemical researches which he had recently made on the composition of the scales of the gar-pike. He stated that he had discovered fluorine as one of their components, and had etched glass with the fluo-hydric acid, eliminated from the ashes of the scales by the action of sulphuric acid. The analysis was yet incomplete, but he would state that the scales contain 45.2 per cent. of animal matter, destructible by heat, and that the mineral matters consist of phosphate of lime, fluoride of calcium, and phosphate of magnesia, with some carbonate of lime. The proportion of lime, in 100 grains of the ashes, was 45.1 per cent., and of magnesia 8.8 per cent., while the phosphoric acid, already separated in this preliminary or qualitative analysis, was 29.96 per cent.

Dr. Jackson remarked that the search for fluorine was suggested by an idea communicated to him by M. C. Girard, that the scales of fishes were "supposed to be anatomically homologous with the enamel of teeth," an idea that now is sustained by chemical analogy.

ON THE PRODUCTION OF BORACIC ACID AND AMMONIA BY VOLCANIC ACTION. BY ROBERT WARRINGTON, F.C.S.

The simultaneous occurrence of boracic acid and ammonia in the neighborhood of volcanoes has been frequently observed, and its cause has given rise to a good deal of speculation, although no very definite conclusions have as yet been arrived at. Some information and specimens received from the Island

of Vulcano, which is situated about twelve miles north of Sicily have enabled me to make a few experiments, which, though not so complete as I could have wished, appear to throw some light upon this point. "The height of the volcanic mountain is estimated at about 2,000 feet, and its crater is about 700 feet deep. The area at the bottom, which may be about ten acres in extent, is covered with small, loose pieces of limestone, just as though it had been Macadamized, and the ground is so hot as rapidly to destroy the leather of the shoes. On thrusting a thermometer between the stones, it indicated, at different points, temperatures varying from 250° to 500° Fahrenheit. On looking over this area from the top of the crater, one side of it appeared as if covered over with beautifully-white drifted snow. On reaching the spot, however, this white appearance was found to be caused by a deposit of finely-crystallized boracic acid. On removing this incrustation, which formed a layer of about an inch in thickness, and digging with a pick-ax, there spumed up a mass of red-hot fused lava, similar in appearance to the slag of a glass-house; this consists of fused saline matters in cohesion with volcanic debris. In other parts of the crater there are holes like foxes' holes, from which blue jets of volcanic flame are issuing continually, and a deposition of sulphur occurs all around.

"The boracic acid rises in vapor, and condenses on the surface of the ground at the bottom of the crater like a light drifted snow; and when gathered up, the surface becomes covered again with sublimed acid in two or three days. To ascertain this point more decidedly, some hogshead casks, having their heads removed, were filled with broom-plants and twigs, and were placed over parts of the area from which the boracic acid had been carefully cleared away. In a few days the acid had been vaporized into them, and had deposited in crystals like hoar-frost all over the twigs. On digging down for about eight inches, wherever this boracic acid occurs on the surface, a red-hot mass of sal-ammoniac is always found; sulphur comes up also with these. This volcano is said to realize to the proprietors about £1,000 per annum. The products are sulphur, from fusing the stone; sal-ammoniac, from the lixiviation of the scoria or lava; and boracic acid, large quantities of which are reported to be obtained annually from this source. The sides of the volcano are of sulphur-stone, and brimstone is dug up all around for miles. The mountains produce also alum, which exists in the schistose rocks; and there are likewise large beds of lignite; but nowhere do we find sal-ammoniac or boracic acid, either at Vulcano or in Tuscany, separate from one another. Had they done so, we should certainly have found traces of it somewhere, but, so far as I know, this has never been observed; and it is certain that, at Vulcano, whenever the acid lying on the surface is removed, the melted matter underneath is found to contain salts of ammonia. It follows, therefore, that they must both be produced from one and the same stratum, in which they occur in some form of combination, from which they are separated by heat. In what substance can they exist together?"

An examination of the sublimate scraped from the surface of the crater, shows that the ammoniacal salt was not a portion of the fused mass mentioned, but had been obtained by its lixiviation and subsequent crystallization. The

boracic acid, however, was in the state in which it was found, and had the form of white glistening scales of a nacreous luster, tinged in parts with traces of adherent sulphur, and possessing a greasy, talcose feel. It was, in the first instance, boiled with diluted hydrochloric acid, allowed to become clear by subsidence, and the solution decanted from the undissolved portion. The latter was washed, to remove the adhering acid, and boiled with a weak solution of caustic potash, without the least trace of ammonia being liberated. The residue was collected, washed with distilled water, and dried. Some caustic potash was next fused in a tube of hard glass, and, while in this state, was found to yield no evidence of ammoniacal gas. A fragment of the dried, white, insoluble residue was then dropped into the potash, and the fusion repeated. Strong evidence of the formation and liberation of ammonia was at once indicated. It was obvious, from this experiment, that the ammonia could not have been really formed in this substance, but must have been produced by some decomposition effected by the potash. These phenomena recall to mind the interesting compound of boron and nitrogen discovered in the year 1842 by Mr. Balmain, who applied to it the name of Ethogen, and which has since been examined by Professor Wöhler. This compound is produced by heating borax and ferrocyanide of potassium, in their anhydrous states, to a full red-heat, in a covered crucible. The white, infusible, porous mass which results from their action is washed with a large quantity of boiling water, acidulated with hydrochloric acid. The nitrate of boron so obtained is insoluble in water and acids, even when concentrated; but when fused with caustic potash, ammonia is copiously evolved, and if heated in a current of steam to a moderate red-heat, it is entirely converted into boracic acid and ammonia. These characters correspond with those of the white compound examined, as far as the evolution of ammonia is concerned, but owing to the small quantity at my disposal, I was unable to determine the presence of boracic acid, or rather of boron, except by its peculiar phosphorescence before the blow-pipe flame. The existence of this compound in active volcanoes would also explain in a satisfactory manner the simultaneous presence of boracic acid and ammonia.

ON THE OCCURRENCE OF OXALATES IN THE MINERAL KINGDOM. ANALYSIS OF TWO NEW SPECIES.

Dr. Heddle, in a communication to the Royal Society, Edinburg, describes two new oxalates recently discovered in a copper mine of Westmoreland, England. Two oxalates only have been previously known in the mineral kingdom; the one an oxalate of iron, analyzed by Rammelesberg, and named by him Humboldtine; the other an oxalate of lime called Whewellite. In regard to the new minerals, Dr. Heddle says, I found one to be an oxalate of lime, differing from Whewellite in having six additional atoms of water of crystallization. Associated with these white crystals was a purplish red substance, which appearing to me to be new, I submitted also to analysis, when it proved to be an oxalate of potash, with ten atoms of water of crystallization. The color was due to some oxalate of cobalt. It is always desirable that a

mineralogist should be able to account for the occurrence of every substance which comes under his notice. This is more especially the case when the substance is of an organic nature, and in general we have little difficulty in satisfactorily explaining even such occurrences. The mineral Humboldtine, for instance, being found either imbedded in lignite, or associated with decomposing succulent plants, leaves no room for doubting that, as it is organic in its matrix, so also it is organic in its origin. I am afraid, however, that our ingenuity will be taxed rather severely to account for the three other oxalates which we are now acquainted with, two of these having been found deep in the womb of the earth, associated with a metallic lode. I think there can be little question that they are of secondary formation, having resulted in some way or other from the operations connected with the working of the mine; but I profess to be perfectly unable to offer any explanation which appears even to myself to be satisfactory. One theory has been brought forward—a theory which I can not but dissent from; it is that the minerals were originally bi-carbonates—that metallic potassium having been brought into contact with them, an atom of oxygen was abstracted, the result being necessarily oxalates. This does not appear satisfactory; neither bi-carbonate of lime or of potash have yet been found in nature; and I can not place myself among those who, whenever they wish to account for volcanic action, or to get out of any difficulty, call in the aid of metallic potassium. I am very far from thinking that no satisfactory theory can be brought forward, but I am content for the present to look upon the occurrence of these oxalates as one of many proofs that as yet we know but too little of the operations carried on in nature's laboratory. The first of these minerals has been named Conistonite, from the locality; and the second Heddlite, after the analyst.

ON THE COMPOSITION AND PREPARATION OF WRITING INKS.

The following is an abstract of a paper recently read before the Society of Arts, Edinburg, by Dr. J. Stark:

The author stated that in 1842 he commenced a series of experiments on writing inks, and up to this date had manufactured 229 different inks, and had tested the durability of writings made with these on all kinds of paper. As the result of his experiments, he showed that the browning and fading of inks resulted from many causes, but in ordinary inks chiefly from the iron becoming peroxygenated and separating as a heavy precipitate. Many inks, therefore, when fresh made, yielded durable writings; but when the ink became old, the tannogallate of iron separated, and the durability of the ink was destroyed. From a numerous set of experiments, the author showed that no salt of iron and no preparation of iron equalled the common sulphate of iron —that is, the commercial copperas—for the purpose of ink making; and that even the addition of any persalt, such as the nitrate or chloride of iron, though it improved the present color of the ink, deteriorated its durability. The author failed to procure a persistent black ink from manganese, or other metal or metallic salt. The author exhibited a series of 18 inks which had either

been made with metallic iron or with which metallic iron had been immersed, and directed attention to the fact that though the depth and body of color seemed to be deepened, yet in every case the durability of writings made with such inks was so impaired that they became brown and faded in a few months. The most permanent ordinary inks were shown to be composed of the best blue gall nuts with copperas and gum, and the proportions found on experiment to yield the most persistent black were six parts of best blue galls to four parts of copperas. Writings made with such an ink stood exposure to sun and air for twelve months without exhibiting any change of color; while those made with inks of every other proportion or composition, had more or less of their color discharged when similarly tested. This ink, therefore, if kept from molding and from depositing its tannogallate of iron, would afford writings perfectly durable. It was shown that no gall and logwood ink was equal to the pure gall ink in so far as durability in the writings was concerned. All such inks lost their color and faded sooner than pure gall inks, and several inks were exhibited which, though durable before the addition of logwood, faded rapidly after logwood was added to them. Sugar was shown to have an especially hurtful action on the durability of inks containing logwood—indeed, on all inks. Many other plain inks were exhibited, and their properties described—as gallo-sumach ink, myrobalans ink, Range's ink—inks in which the tannogallate of iron was kept in solution by nitric, muriatic, sulphuric, and other acids, or by oxalate of potash, chloride of lime, etc. The myrobalans was recommended as an ink of some promise for durability, and as the cheapest ink it was possible to manufacture. All ordinary inks, however, were shown to have certain drawbacks, and the author endeavored to ascertain by experiment whether other dark substances could be added to inks to impart greater durability to writings made with them, and at the same time prevent those chemical changes which were the cause of ordinary inks fading. After experimenting with various substances, and among others, with Prussian blue and indigo dissolved in various ways, he found the sulphate of indigo to fulfil all the required conditions and, when added in the proper proportion to a tannogallate ink, it yielded an ink which is agreeable to write with, which flows freely from the pen, and does not clog it; which never molds, which, when it dries on the paper, becomes of an intense pure black, and which does not fade or change its color, however long kept. The author pointed out the proper proportions for securing these properties, and showed that the smallest quantity of the sulphate of indigo which could be used for this purpose was eight ounces for every gallon of ink. The author stated that the ink he preferred for his own use was composed of twelve ounces of gall, eight ounces of sulphate of indigo, eight ounces of copperas, a few cloves, and four or six ounces of gum arabic, for a gallon of ink. It was shown that immersing iron wire or filings in these inks destroyed their durability, as much as similar treatment destroyed ordinary inks. He therefore recommended that all legal deeds or documents should be written with quill pens, as the contact of steel invariably destroys more or less the durability of every ink. The author concluded his paper with a few remarks on copying inks and indelible inks, showing that a good copying ink has yet to be sought for, and that indelible inks,

which will resist the pencilings and washings of the chemist and the forger, need never be looked for.—*London Artizan.*

CLEANING AND RENOVATING COTTON WASTE.

Cotton waste, or the tangled and spoiled products of the cotton manufacture, is extensively used in wiping all kinds of machinery, and is also deposited in considerable quantities in the "boxes" of cars and locomotives, in which situation it serves as a sponge for keeping the axle always sufficiently lubricated. No other substance has been found so desirable as cotton waste for this purpose, and the price of the article fluctuates slightly with the increasing demand and variable supply; but for the last few years has been about 9 to 9½ cents per pound by the ton.

Several efforts have been made to renovate and cleanse the old and saturated waste, but until lately without success. The article has refused to assume a state fit for further service on machinery, and the expense of preparing it for the paper manufacture has exceeded its final value. The Erie Rail-road consumes in this manner ninety tons per annum, but a method has lately been invented by Mr. Charles D. Cooper, a car-inspector in the employ of that Company, which promises to revolutionize the wasting business entirely. Mr. C. has erected a small establishment where this refuse material may be completely regenerated at an expense of only about 1½ cents per pound. There are two species of foul waste—one, that which has been used for wiping machinery until its pores are pretty well filled with bad oil, iron filings, chips and dust; the other, waste which has been kept saturated in oil in an axle-box until the oleaginous fluid has become "gummy," or hard and sticky. The first class makes only clean waste, after going through the necessary manipulations, but the box-waste makes oil and soap as well as waste, so that what was originally a nuisance becomes, like a dead horse in the hands of the Parisian dealers, a very considerable source of revenue. Box waste is first subjected to a great compression in a hydraulic press, and the drippings are, or may be, clarified into clear and transparent oil. The dry mass is next treated with a suitable alkaline solution, and a kind of soap is produced, which is, however, principally consumed at a later stage in washing the fibrous material. Steam is liberally employed in warming, and the mass is finally rinsed by machinery, dried, and "picked" or beaten into a condition actually superior for some purposes to the new material fresh from the mill.

ON THE MANUFACTURE AND PROPERTIES OF GLYCERINE.

Mr. George Wilson, in a communication to the Royal Society, states that in the course of a long series of experiments conducted on a large scale, he has observed that the so-called neutral fatty bodies may be resolved, without danger of injurious decomposition, into glycerine and the fatty acids, provided that the still be maintained at a uniformly high temperature, and that a continuous current of steam be admitted into it. The temperature required for splitting the fats into their proximate elements varies with the nature of the

body itself, but all hitherto tried may be resolved into glycerine and fatty acids at a temperature of 560° Fahrenheit, many at much below that temperature. In the case of palm oil, cocoa-nut oil, fish oil, animal tallow, Japan vegetable wax, and several others, they have yielded satisfactory results, the fatty acid and glycerine distilling over together, but no longer in combination, and separating in the receiving vessel. Mr. Wilson enumerates the properties of glycerine as follows:—It has a taste like sugar; is applicable to the cure of burns, rheumatism, and ear-diseases; it is a substitute for cod-liver oil, and also for spirits of wine; also for the preservation of flesh; and can be applied to photography, and preserving animals in their natural colors.

In regard to the application of glycerine to medicine, MM. Cap and Garot have recently published some interesting statements. Glycerine may be used in preparation of pharmaceutical preparations to great advantage, in the place of every variety of oils or fatty bodies, whose use presents many inconveniences in external application. Thus oil does not dissolve, except perhaps in very small proportions, the metallic salts, or those with a metalloid base. It combines or decomposes in contact with the alkalies or more powerful acids. When we endeavor to make it act on fresh plants, it removes very little but chlorophyl and some aromatic principles, but nothing is less certain than its action on the active principles. The vegetable juices, extracts, gums, sugar and tannin are insoluble in it. Moreover, all fatty bodies present disadvantages in surgical practice. Their application soils apparatus, and renders wounds more difficult to cleanse. Oils, pomades are liable to become rancid and injured by simple contact with the air. But glycerine presents none of these inconveniencies. Its solvent power with respect to the metalloids, the salts, and neutral organic bodies, equals, if not surpasses, that of water or alcohol. In prescriptions it will unite with either aqueous or alcoholic liquids. It is not likely to become rancid or spoiled. Finally, in surgical practice it has this valuable quality, that any wound may be cleansed, or bathed with either tepid or cold water; all topical applications of which glycerine forms the vehicle, being so very soluble.

Gum Arabic is very soluble in glycerine. One part of glycerine and three parts of powdered gum form a thick mixture which spread on cloth or paper, adheres well and possesses a suppleness which remains unchanged by contact with the air. Five parts of glycerine and one of powdered gum form a transparent mucilage of a good consistence. By varying the proportions of this mixture gum plasters may be prepared which retain their suppleness, and into the composition of which various medicinal extracts may be introduced. For instance, a little glycerine added to the gummy mixture used for the preparation of court-plaster renders the latter flexible and prevents it from cracking. Collodion, which of late has come into extensive use, has one great inconvenience, that of drying too rapidly, and contracting the tissues on which it is applied, and cracking. In a word, it is wanting in flexibility and elasticity. Glycerine dissolves in collodion to a sufficient extent to overcome the difficulty. 100 parts of collodion and 2 of glycerine give a perfect preparation for surgical uses.

The following are the conclusions given respecting the solvent action of

glycerine:—1st. Its solvent action approaches that of dilute alcohol more nearly than that of distilled water. 2d. In general those bodies are most soluble in glycerine which are most soluble in alcohol. 3d. In most cases the solvent power of alcohol is superior to that of glycerine; in some others their power is nearly equal, and in the case of strychnia, it possesses a greater solvent action. It must also be remembered that glycerine adds to any compound of which it forms a part, nothing but innocent, if not softening and sedative properties, whereas alcohol has very active properties, which, in certain cases, would be very injurious.

COAL-TAR AND ITS PRODUCTS.

At a recent meeting of the London Society of Arts, Mr. Grace Calvert gave the following somewhat detailed account of the substance known as coal-tar, and the many and curious products which science, within the last few years, has extracted from it:—Coal-tar, as is well known, is the product left in gas-works in the condensers, being formed with the gas from coal, and afterward deposited from the gas upon cooling. This substance was generally sold to the tar distillers, who obtained from it a volatile fluid called coal naphtha, a light oil, composed principally of carbonic acid and a heavy oil of tar, a solid substance, called pitch, being also left in the retort. Coal-tar has of late years been used in paving. When this substance, together with tar and asphalte, is heated, and poured while in a liquid state upon gravel, between the interstices of the paving stones, the whole is bound together so durably, as not to require repaving for several years. There is, however, this important sanitary advantage connected with this plan, namely, that no impure matter nor stagnant water can percolate through this impervious pavement and collect beneath, giving forth noxious effluvia, to the injury of the health of the inhabitants. This pitch, when submitted to distillation in retorts, yields a porous but at the same time a dense coke, and the oils distilled in the operation can be employed to advantage for lubricating machinery. Coal-tar has also been applied, when mixed with gutta-percha or India-rubber, to insulate telegraph wires, and prevent metals from being acted upon by the atmosphere. One of the first products which comes over in the distillation of tar is a mixture of very volatile hydro-carbons, which has received the name of crude naphtha, and this, when again distilled, is sold under the name of naphtha. When it is intended to apply this product to more particular purposes, it is purified by mixing it with 10 per cent. of its bulk of concentrated sulphuric acid; and when the mixture is cold, about 5 per cent. of peroxyd of manganese is added, and the upper portion submitted to distillation. The rectified naphtha found in the receiver has a specific gravity of 0·85. This substance is used to dissolve caoutchouc. Rectified naphtha is also used for mixing with wood naphtha, to render the latter more capable of dissolving resins for the production of cheap varnishes. This rectified naphtha, submitted to a series of further purifications, has received from the eminent French chemist, named Pelouze, the name of "benzoin" or "benzole," which has the property of removing with great facility spots of grease, wax, tar, and resin, from fabrics

and wearing apparel, without injuring the fabric, its color, or leaving any permanent smell or mark, as is the case with turpentine. The numerous uses to which this valuable product can be applied in manufactures renders it of extensive employment in place of alcohol and other fluids which are, generally speaking, too expensive for common commercial purposes.

As an instance, Mr. Calvert cited that in Yorkshire there was a large quantity of wool dyed before it was spun, principally for carpet manufactures. It was then necessary to oil this dyed slubbing-wool, as it is called; and up to the present time no means had been discovered of removing the oil without injuring the color; and thus this oil remaining in the fabric materially injured the brilliancy of the color, as well as rendered the carpets thus manufactured liable to become sooner faded or dirty. Now, by the employment of benzole, which has not the property of dissolving colors, the oil can be removed from such fabrics, and the full brilliancy of the colors fixed on this slubbing-wool can be restored. He also states that this benzole can be employed with advantage in photography, in removing the grease from daguerreotype plates. When this benzole is treated with strong nitric acid, it gives rise to a substance called nitro-benzole, which is every day becoming more and more used as a substitute for essence of bitter almonds, used in perfumery. It is thus interesting to observe that, by the triumphs of chemistry, a delicious perfume has been produced from the noxious smelling refuse of coal. The next products he mentions which are distilled from coal-tar, are those denominated light oils of tar, which remain on the surface of water, and are applied, together with the heavy oils, to the preservation of wood from rotting. The introduction of the fluid into wood is effected by placing the wood in close iron tanks, exhausting the air, and then forcing the oil into the whole substance of the wood, under a pressure of from 100 to 150 lbs. to the square inch. There exists in these light oils of tar a highly interesting product, called tar kreasote, or carbolic acid, which possesses extraordinary antiseptic properties: such, for example, as prevent the putrefaction of animal substances. Mr. Calvert has applied it with success in preserving bodies for dissection, and also in keeping the skins of animals intended to be stuffed. Owing to its peculiar chemical composition, he has also employed it successfully in the preparation of a valuable dye-stuff, called carboazotic acid, which gives magnificent straw-colored yellows on silk and woolen fabrics. The carboazotic acid, prepared from the above-mentioned substance, can be obtained very pure, and at a cheap rate, thus enabling the dyer to obtain beautiful yellows and greens, which are not liable to fade by exposure to the air, as is the case with most of those colors when obtained from vegetable dyes. The advantage of the acid so prepared is, that it is entirely free from oily or tarry substances which have the property of imparting a disagreeable odor to the dyed fabrics. The intense bitter which this acid possesses induced him to have it tried as a febrifuge; and Dr. Bell, of Manchester, has succeeded in curing several cases of intermittent fever by its aid. Mr. Calvert has lately applied carbolic acid in a manner that offers advantages to dyers and calico-printers. It is well known that extracts made from tanning matters can not be kept for any length of time without undergoing deterioration, in consequence of the

tanning matter which they contain becoming decomposed and transformed, by a process of fermentation, into sugar and gallic acid: which acid, he has ascertained, not only has no dyeing properties, but, on the contrary, that it is injurious, from having a tendency to remove the mordants which are employed to fix the colors on the cloth. It is also known that gallic acid possesses no tanning properties. By adding a small quantity of carbolic acid to the extracts of tanning matter, they can in future be kept and employed by the dyer as a substitute for the substance from which they are obtained, by which will be gained the double advantage of saving labor and obtaining a better effect from the tanning matters. The third substance which passes off in the distillation of tar is called heavy oil of tar. This oil contains a singular organic product, first discovered by Dr. Hofmann, of London, and called by him "kyanol," or "aniline," which possesses the property of giving, with bleaching-powder and other agents, a magnificent blue color. This fact led Mr. Calvert to observe that this last-mentioned substance, as well as carboazotic and indigotic acids, being produced as well from indigo as from coal-tar, proves the great similarity and chemical connection which exists between the products of these two substances, and induces him to believe it extremely probable that these products will be employed within a few years as substitutes for indigo and madder. Laurent has succeeded in obtaining two products from naphthaline, which have a great analogy to the coloring principles of madder. A substance, for instance, called chloronaphthalic acid, has the same composition as the coloring matter of madder, and would be identical if the hydrogen gas was substituted for the chlorine which the acid contains. Hence the chloronaphthalic acid has the property of giving, with alkalies, a most superior red color. When the coloring principle of madder is treated with nitric acid, a substance called alizaric acid is obtained, which is identical with a substance also obtained from naphthaline, called naphthalic acid. Naphthaline is a solid, white substance, which distills in large quantities during the distillation of tar. It is an interesting fact, that if coals are distilled at a low temperature, the products obtained differ from those which are produced when coals are distilled at a high temperature, as is the usual custom in the manufacture of gas. Without entering into all the details on this point, he mentioned one of the most striking differences of results, namely, that in place of the naphthaline, a valuable lubricating agent, called paraffine, a solid substance, and a large quantity of carburetted hydrogens are also distilled, which, being free from smell, are valuable for commercial purposes, and have received the general name of paraffine oil, or, as Dr. Lyon Playfair remarked in his report of the Great Exhibition of 1851, it is "liquified coal gas." This paraffine oil, when mixed with other oils, is now extensively used in cotton-mills both in England and the United States. Solid paraffine is also obtained in the distillation of peat, and is employed for manufacturing candles, there being added to it about 20 per cent. of wax. These candles are remarkable for their transparency and the pureness of their flame.

OILS FOR LUBRICATION.

The procurement of a suitable oil or substace for the lubrication of mechanism, is a subject of great importance. All pieces of machinery, the works of man, are nothing less than inanimate bodies, imitations of the works of the Creator, as displayed in the animate creation; and as is proved by practical experience, the nearer the imitation of the one to the other, the nearer perfection is arrived at. Nature supplies all animals with a lubricating medium between the solid parts of the joints, as well as the internal passages of the body, to facilitate the motion of solids and fluids, and the outer covering of animals is furnished with the same oily substance in quantity and quality according to the density of the element in which they move, and the velocity they maintain. Marine animals are striking instances of this. Every animate being possesses the fullest facility of motion with the least muscular exertion, thus all mechanism designed for motion must be governed by the same laws, and its economy can only be maintained on the same principles of giving facility to motion, which can only be done by the purity and chemical properties contained in the oil or substance employed for lubrication. This theory is most beautifully developed in that class of mechanism connected with our cotton manufacture. The competition to which this business has been subject has brought such an amount of science to bear upon its economy as is not to be met with in any other class. Science has brought every portion of the mechanism of the cotton-mill under the strict laws of motion and force, and the most scrutinizing tests are employed for ascertaining the facilitating or the retarding influence any new oil may offer previous to its application. By this course of study such an immense amount of motion is obtained from a given power, and with a wearing of the parts so immeasurably small, that it can only be equaled by motion in tho natural body. The power or force necessary to give to the spindle a revolution of three thousand per minute is so infinitely small that it can scarcely be calculated. With the vast number of separate bodies in motion, some of them moving with great rapidity, the freedom from accidents, and the security to life and property in those establishments, is surprising. Cotton manufacturers consume the largest proportion of the sperm oil imported, for which they pay a high price—a matter, however, of secondary importance, when the increase of power thereby produced is taken into consideration. This is the only class of mechanism upon which artificial power has been properly developed, with the exception, perhaps, of private carriages, where the power of the horse has been greatly economized by the use of patent axles, giving stability and facility of motion, and preventing the destructive influence of oscillation; thus lighter carriages and cattle are employed, and the speed has been increased, with greater security and at less cost. It is now considered economical to purchase the most expensive oils for the axles even of town-carts. Railway and marine machinery suffer greatly from friction, and its inseparable companion, oscillation. The laws that govern motion in the manufactory are precisely those which ought to govern motion on the rail, but these two great interests

manage their mechanism on precisely opposite principles; hence the economy of the one and the expensive character of the other. The difference appears to be that the factory is worked with a view to individual profit, the other for that of a company. The ear of one is ever keenly open to the discoveries of science, the other is ever closed, except it happens to flow through certain favored channels. A new era appears, however, to be dawning upon railway machinery, as several of the English leading railway companies have accepted the offer of some of their engine-drivers to work by contract. If this plan should be liberally carried out by the companies, it will be the first step toward the development of locomotive steam-power. The personal interest and responsibility will ultimately work as great changes on the rail as the manufacturer has accomplished in his mill, and will lead to the same principles being carried out in both classes of mechanism. When that is accomplished it is impossible to say at what speed it may not be perfectly safe to travel, and how much the cost may be reduced. The same remarks are applicable to marine machinery, and if the substances employed as lubricating materials by the large steam-ship companies were tested, it would be found difficult to meet with substances offering greater resistance, and, in other respects, more chemically unfitted for the purposes to which they are applied. The purity of the oil supplied to the marine engine is of very great importance. The large bearing surfaces exposed to friction, and the nature of the metallic alloys of which they are composed (copper, zinc and tin) render them susceptible of electrical influence, and that influence once exerted, is always liable to a repetition, producing heat, expansion, and all the consequences resulting therefrom. If this subject were better understood by the companies, or some personal interest brought to bear upon the development of marine power, it would lead to much greater economy in its working, and add much to the speed of the ship. A better knowledge of the science of lubrication might also lead to the idea of lubricating the ships themselves, after the manner of marine animals. If that could be accomplished, the velocity of ships might be much increased. It is quite certain, from the great necessity of economizing steam power, that companies and individuals employing it must, sooner or later, use better lubricating materials; their own interests will force it upon them. But the great question is, where are they to be had. It does not appear possible to obtain a greater supply of sperm oil, or oils or seeds of a better quality, than at present. Foreigners, as a body, have an objection to adopt any thing new, unless, indeed, when they run no risk by doing so; therefore, so long as a favorable market is found for their produce, we shall have no improvement, and it must rest with the home cultivator.—*Journal of the Society of Arts.*

IMPROVEMENTS IN SOAPS AND OILS.

Use of Linseed Oil-cake in the Manufacture of Soap.—Pelouze states that old oil-cakes may be advantageously used in the manufacture of an economical soap. All that is necessary is to mix them with an alkaline solution; but the quantity prepared must be small, as the abumenoid matter contained

in them begins to decompose in about a fortnight, producing a disagreeable odor.

On the Preparation of Oil from Seeds, Nuts, etc.—Pelouze states that any edible oil will have a different composition and taste, according to the length of time that has elapsed before the seed from which it has been extracted was submitted to pressure. The best oils for the table are those which have been extracted immediately after the crushing of the seed.

New Oil.—At a recent meeting of the Liverpool Chemists' Association, says the London *Lancet*, sample of *shark liver oil* was presented, and possesses some peculiar interest. Hitherto sperm oil possessed the lowest specific gravity, .875, and was the lightest oil known; but shark oil is found to have a specific gravity of only .866. It came from Marseilles, and was stated to be procured from sharks caught on the coast of Africa.

Fish Blubber Soap.—R. Johnston, of Aberdeen, North Britain, has taken out a patent for manufacturing soap as follows:—He first boils fish or blubber for some hours, then lets the contents in the boiler settle, and takes all but the deposit at the bottom, which is thrown out and composted to make manure. He then strains the liquor through a coarse bag, which is put into a press, and all the loose matter pressed out. That which is left in the bag is put into the soap kettle, with one fourth its weight of tallow, and boiled with caustic, soda, or potash for seven hours. The soap thus made is stated to be without smell, and of good quality.

Purifying Whale Oil.—Peter Arkell, of Stockwell, England, has taken out a patent for purifying whale oil as follows:—He puts common whale oil in an iron still, with one ounce of sal ammoniac and a pint of turpentine to each gallon, and applies heat to the still. The still is stirred by a rod passing tight into it during the period distillation is going on. The oil that is distilled over is stated to be peculiar in its character, and of a superior quality. A quantity of black pitch is left behind in the still.

Improved Soap.—W. A. Armand, of London, has secured a patent for the following method of making a soap called "saponitoline," and which is stated to be of a superior quality. He places in a copper 88 gallons of soft water, and mixes with it 112 lbs. of crystal soda, or 79 lbs. of salts of soda, and, after two or three hours have elapsed, agitates it, and adds 112 lbs. of common soap. He then heats the whole to 40° or 45° Centrigrade, and adds 17 lbs. of pearl-ash, and 17 lbs. of quick lime. When ebullition has commenced in the copper, he slowly agitates the heated mass, and pours into it about 5 gallons of mucilage of linseed or marsh-mallow seed, after which he adds 7½ lbs. of borax, or about 2½ lbs. of calcined alum. When the whole is well mixed in the copper, and the liquid presents the appearance of being perfectly homogeneous, he leaves it to boil on a slow fire for three quarters of an hour. The fire is then extinguished, the copper covered over, and the temperature allowed to fall to 55° or 60°. He then pours the liquid into barrels, where it becomes solidified in about 24 hours (supposing that hard soap has been used; if otherwise, it remains in a gelatinous state).

Bleaching Oils, Resins, etc.—An improvement has been patented in England for causing oils, fats, and resins, when in a heated state, to be thrown by

centrifugal force through fine wire gauze into an inclosed chamber containing chlorine. The apparatus is like a centrifugal sugar pan, surrounded with a lead chamber containing the bleaching gas. A slide is employed to shut off communication (when required) between the revolving pan and the bleaching chamber.

New Preparation of Wool Oil.—The following is a claim of a patent recently granted to Thomas Barrows, Esq., of Dedham, Mass., for a new preparation of oil for wool and other purposes:—I claim, for the treatment and imbuing of wool, during or previous to its manufacture into yarn or cloth, the application thereto, of mucilage, possessing an attraction for water, such being found in sea-mosses and allied vegetable productions, or in various seeds, such as flax-seed, it being used either alone or in mixture with an oil, or some other material. I use any of the oils, adapted to oiling wool, in mixture with mucilage, although some mixture, by rest, for a longer or a shorter time, will become separated into oil, which floats, and mucilage which subsides; but prefer the prepared oleic acid or olein mixture, as it often remains uniform several days. I, however, lay no claim to the application of olein, as described.

Action of some Animal Fluids on Fats.—It is known that M. Bernard attributes to the pancreas the property of emulsionating fatty substances. M. Bloudlot, Professor in the School of Medicine at Nancy, finds that this property does not belong exclusively to the pancreas, but that the chyme possesses it to an equal degree. M. Longet now announces that the seminal fluid possesses this property in a much higher degree, and that under a temperature of 35° to 40° Centigrade, during 14 to 16 hours, fat is decomposed into fatty acids and glycerine. Before subjection to heat, the emulsion has an alkaline reaction, and after this treatment it is acid.—*Silliman's Journal.*

Adulterations in Oils.—The detection of oils obtained from the cruciferous vegetables, such as coiza, rape, camelina, mustard, when mixed with other oils, has hitherto been a matter of some difficulty. The following test is proposed by Miahle: 25 to 35 grams of the oil in question are boiled in a porcelain capsule, with two gram's of pure caustic potash (prepared with alcohol), dissolved in 20 grammes of distilled water. After boiling for a few minutes, it is thrown upon a filter previously moistened, and the alkaline liquor flowing from it is tested with paper impregnated with acetate of lead or nitrate of silver. A black stain, showing the presence of sulphur, indicates that one of the above oils has been added. A still more delicate method is to boil the mixture in a silver capsule, which will be blackened if one of the above oils be present even to the proportion of 1 per cent.—*Artizan.*

Purification of fixed Oils.—The colorless olive oil which is used by watchmakers is exceedingly dear, and yet the simple process of its purification appears to be so simple that any watchmaker may prepare it himself. If common olive oil be mixed with an equal quantity of very strong spirits of wine (sp. gr. 0·853) and allowed to stand for about 14 or 15 days, during which time it must be repeatedly shaken; already, in the course of a few days, the yellow color of the oil begins to disappear, and then gradually fades, until, at the end of the period mentioned, the oil becomes colorless. If the mixture

be exposed to the direct action of the sun, this change takes place much more rapidly. The under layer of oil is separated from the spirit, which floats upon it, and is preserved in well-closed bottles (stoppered, or with plugs of wood or gutta-percha); the spirit may also be prepared for another operation, or if large quantities be employed, it may be distilled after each operation. The removal of color is not the only advantage which is gained by treating olive oil with alcohol, for a considerable quantity of the margarine which it contains is also dissolved out, and hence oil so treated will not solidify so readily as the raw oil. The process just described, and which is undoubtedly better than treatment, first with sugar of lead, then with sulphuric acid, washing with boiling water, and drying with chloride of calcium, or any other of the processes in common use is applicable, more or less, to all other oils, even to coarse fish oils. It may be of importance to painters in oil, who are anxious not to injure the delicate tints of ultramarine, rose, scarlet, and other delicate shades of red, and in fact of all pure tones, to know, that linseed oil, even the darkest and muddiest, may be so far bleached as to become bright and clear, and have only a slight yellow tinge; a good deal of oil is now purified in this manner in Great Britain.—*Polytechnisches Journal.*

On the employment of Sea-weed in the manufacture of Soap.—Mr. Claussen, of flax-cotton notoriety, in a paper before the British Association, stated the following facts relative to the employment of marine plants in the manufacture of soap:

"When I was experimenting on several plants for the purpose of discovering fibers for paper pulp, I accidentally treated some common sea-weeds with alkalies, and found they were entirely dissolved, and formed a soapy compound which could be employed in the manufacture of soap. The making of soaps directly from sea-weeds must be more advantageous than burning them for the purpose of making kelp, because the fucusoid and glutinous matter they contain are saved and converted into soap. The Brazilians use a malvaceous plant (Sida) for washing instead of soap, and the Chinese use flour of beans in the scouring of their silks; and I have found that not alone sea-weed, but also many other glutinous plants, and gluten, may be used in the manufacture of soap with advantage."

METHOD OF RAPIDLY BLEACHING WAX, AND PURIFYING TALLOW, OILS, ETC.

Wax, properly speaking, consists of pure wax and a coloring matter. There are several kinds of wax, distinguished commercially by the relative amount of coloring matter which they contain. Formerly it was supposed that wax could only be bleached by the action of sunlight. To effect this object the operations were commenced early in the spring, and continued for 3 or 4 months. The wax required to be made into ribbons of great tenacity, or feathered as zinc is, by being poured into water. This must be repeated several times during its exposure to the sunshine. The whole process requires a heavy outlay of capital, and the results are moreover uncertain and variable according to the weather. In order to diminish the amount of capital which

required to be sunk in this branch of trade, and above all to shorten the time required to bleach the wax, M. Cassgrand, of France, some years since, invented a process which has been most successful, but has only recently come before the public.

This process consists in melting the wax by means of steam until it becomes very liquid, and then passing it along with the steam through a kind of serpentine worm, by which a large surface becomes exposed to the action of the steam. After traversing the worm, it is received in a pan with a double bottom, heated by steam, where water is added in order to wash it; from this it is elevated by a pump, kept hot by steam, into another pan similarly heated, and where it is also treated with water, and is again passed through the serpentine. This operation is repeated twice, thrice, or four times, according to the quality of the wax. During the passage with the steam through the worm it becomes denser, by absorbing, it is said, and deposits in the upper pan. It is allowed to repose for about 4 or 5 minutes after each passage, and after the last one, about 1 or 2 hours, according to quantity, in order to allow of any impurities to subside. The wax is then granulated in the ordinary way by means of cold water, is allowed to dry during 3 or 4 days, and the action of light and air does the rest, for which one person is sufficient. The whole of the operations do not require more than a few days, are perfectly certain, and attended with no danger. Independent of the advantage which such an apparatus has for bleaching wax, it has also that of enabling its qualities, according to relative whiteness, to be distinguished. For this purpose it is only necessary to present the wax in masses to the end of the worm, and in a second or two the vapor determines the relative color it will yield. This process is also applicable to the purification of tallows and oils; even fish-oil, when passed through the apparatus and washed as described, is completely deprived of its disagreeable smell; and if it be set aside in a place where the temperature only reaches from 59° to 68° Fahrenheit, a fresh deposit will form, and the oil become perfectly clarified and nearly colorless.

This process is worthy the attention of soap-boilers, as it is much more effective than the present method of purifying oils, especially where sulphuric acid is used. The only modification required for the purification of oil would be to divide the oil as much as possible by means of a diaphragm of copper, pierced with holes in the first steam-vessel, and thus expose the largest possible surface to the action of the steam in flowing through the pierced diaphragm into the worm.—*Dublin Journal, Industrial Progress.*

DISTILLATION OF COAL IN HYDROGEN GAS.

It is well known to chemists and others who have experimented in the destructive distillation of coal, that at different degrees of temperature products of very different character are produced—gaseous, liquid, and solid. The gaseous products consist of marsh gas, olefiant gas, carbureted hydrogen, and carbonic acid. The liquids consist of bodies closely analogous to petroleum, and the solids are coke and mineral pitch. The relative proportions of the above products vary with the temperature of the retort; the lower the tem-

perature the less gas and the more liquid produced, and the higher the temperature, the larger the volume of gas. An invention recently patented by Stephen Meredith of Meadville, Pa., has for its object the facilitation of the process of distillation, and this is accomplished by the admission to the retorts, during the distilling operation, of a jet of heated hydrogen gas. In this way the liquids are distilled in an atmosphere of hydrogen, and thus preserved from igneous decomposition, while the hydrogen at the same time takes up a portion of the sulphur and ammonia contained in the coal.

PURIFICATION OF GAS.

A very great improvement in the purification of gas is claimed to have been effected by Mr. Statter of England, by the employment of hydrated clay along with the lime usually employed for this purpose. Hydrated clay unites with the ammonia of the gas as with a base, and at the same time with its sulphuret of carbon as with an acid, and thus removes both of these noxious impurities from the gas exposed to its influence. Its good offices are, moreover, said not to be limited to these, as, in conjunction with the lime, it assists in removing tarry vapor and other impurities. The illuminating power of the gas appears, from a detail of experiments, to be positively increased by the clay purification from 22 to 33⅓ per cent.—*London Builder*, No. 585.

GAS FROM PEAT.

There has been much discussion in Paris in connection with the renewal of the engagements of the city with the gas companies. Attention has been called to the gas manufactured from peat, which for some time has been manufactured in Paris. M. Foucault has been charged with measuring the comparative illuminating powers of coal and peat gas; and the result is in favor of that of peat, its power being 342, while that of coal gas is 100. The manufacture of peat gas is also more simple than that of coal. The peat, if put into an iron retort heated to a low red-heat, affords immediately a mixture of permanent gases and vapors which condense into an oleaginous liquid, which two products separate on cooling. The oil is collected in a special vessel, and the gas passes into a gasometer. This carbureted hydrogen is wholly unfit for illumination, it giving a very small flame, nearly like that from brandy. The oil from the peat is a viscous, blackish liquid, of a strong odor. It is subject to a new distillation, and resolved wholly into a permanent gas and hydrogen very richly carbureted. This mixture is strongly illuminating, giving a flame six or eight times brighter than the first, and of a more lively brilliancy. The two are mixed, and a gas of intermediate character obtained, which is delivered over for consumption.

M. Foucault has made his trials with a photometric method not yet made public. Its unit was not a single wax candle, but a collection of seven candles, arranged in an hexagonal manner, with spaces of one centimeter. A single candle is liable to too much variation, a compensation for which is secured when a number are employed. By this method, a mean of five deter-

minations gave for a burner of peat gas a light equivalent to $23\frac{1}{4}$ candles; and the same burner with coal gas, $6\frac{3}{10}$ candles. The illuminating power of the pure oil from peat, the illuminating material *par excellence*, has been found at equal pressures 705, the intensity for coal gas being 100: and with equal volumes their numbers are as 756 : 100.—*Silliman's Journal.*

ARTIFICIAL GUTTA-PERCHA AND INDIA-RUBBER.

The following communication was read before the British Association by M. Claussen :—

"In the course of my travels as botanist in South America, I had occasion to examine the different trees which produce the India-rubber, and of which the *Hancornia speciosa* is one. It grows on the high plateaux of South America, between the tenth and twentieth degrees of latitude south, at a height from three to five thousand feet above the level of the sea. It is of the family of the Sapotaceæ, the same to which belongs the tree which produces gutta-percha. It bears a fruit, in form not unlike a bergamot pear, and full of a milky juice, which is liquid India-rubber. To be eatable this fruit must be kept two or three weeks after being gathered, in which time all the India-rubber disappears or is converted into sugar, and is then in taste one of the most delicious fruits known, and regarded by the Brazilians (who call it Mangava) as superior to all other fruits of their country. The change of India-rubber into sugar led me to suppose that gutta-percha, India-rubber, and similar compounds, contained starch. I have, therefore, tried to mix it with resinous or oily substances, in combination with tannin, and have succeeded in making compounds which can be mixed in all proportions with gutta-percha or India-rubber without altering their characters. By the foregoing it will be understood that a great number of compounds of the gutta percha and India-rubber class may be formed by mixing starch, gluten, or flour with tannin and resinous or oily substances. By mixing some of these compounds with gutta-percha or India-rubber, I can so increase its hardness that it will be like horn, and may be used as shields to protect the soldiers from the effects of the Minié balls, and I have also no doubt that some of these compounds, in combination with iron, may be useful in floating batteries and many other purposes, such as the covering the electric telegraph wires, imitation of wood, ship-building, etc."

IMPROVEMENTS IN THE SIZING OF PAPER.

The following is a description of a new process for sizing paper, invented by Dr. J. Macadam, of Glasgow. The plan is more particularly applicable in the manufacture of such kinds and qualities of paper as are partially or entirely "resin sized" and machine made, and it consists in the partial or total substitution of aqueous solutions of single sulphates, or of other binary compounds, for the double sulphate of potash and alumina, known by the name of alum, usually employed according to the present system of manufacture. The acid best suited for this purpose is sulphuric acid, and is employed in

quantity sufficient for the neutralization of the whole, or a part of the alkali of the resin size which is used. The quantity or proportions of acidulous solution, when free acids are employed, is accurately determined by alkalimetrical processes; and such acid solutions are added to the paper pulp either before or after the addition of the resinous size. In carrying out the invention, the aid of single sulphates, or other binary compounds in the form of aqueous solutions, and suited in quantity to the alkali present in the size, are used. Paper produced under this system of treatment is peculiarly well-suited for printing by lithography or from engraved plates, as it possesses an absorbent surface of a uniform character. It has also a less injurious effect upon the engraver's plates, and is well-suited for letter-press printing, as it is readily susceptible of uniform damping, and affords a clear impression. The following is a detail of the materials used and the plan followed:

In the preparation of the resin size, as ordinarily used, the resinous matter is dissolved through the medium of water by alkaline compounds, carbonate of soda, or carbonate of potash, for example. When alum is added to such solution in contact with the paper pulp, decomposition of the size-solution takes place; the acid of the alum neutralizes the alkali which is present, and the resin is precipitated in contact with the fibrous matter of the paper pulp. In sizing with resin the antiseptic influence of alum is not required, as in the case of sizing paper by the agency of animal matters; or if at all necessary, it is only so within a very limited extent. The invention, therefore, essentially consists in the application and use of the free acids, or single sulphates, or other binary compounds, by the agency of which the desired neutralization of the alkali of the size-solution is secured in a more economical manner, and with superior results as regards the quality of the paper, than when the chemical effect arises solely from the use of alum in the ordinary way. The agents named are employed to a greater or less extent, in accordance with actual circumstances, introducing at the same time more or less alum as may be advisable. When single sulphates are used to effect by their continued action the neutralization of the alkali of the size-solution, they are applied in accurate atomic proportions. The size-solution is constantly prepared from the same proportions of resin, water, and alkaline compounds, so that whether commercial carbonate of soda or potash, or soda ash be used, the proportion of alkali in a given measure of the size-solution may be as constant within such narrow limits, as any fluctuations in the per centage of alkaline value of such compounds will admit. The strength of the acid aqueous solutions is constant. Thus, taking sulphuric acid as an example, it is employed as an aqueous solution, having a strength of 20° by Twaddell's hydrometer. While this strength is convenient for regulating and measuring the required quantities, the degree of dilution is otherwise unimportant. It is advisable, however, to make this the minimum amount of dilution.

The requisite of the dilute acid is regulated as follows: The size-solution being constant, or nearly so, in alkaline strength, and being used in definite and constant quantity for each class of paper, as sized in any particular engine of the paper-maker's works, according to the capacity of such engine, a preliminary experiment is made to ascertain, by means of a graduated tube (di-

vided into equal spaces) such as is usually in the estimation of the value of alkalies, what number of such graduated spaces filled with acid are necessary for the neutralization of a known proportion of the total amount of size-solution as required for the paper in any particular engine, in accordance with the special variety of paper being manufactured. The point of saturation is ascertained by stirring well the size-solution on each successive addition of the acidulous solution, and until the size-solution so treated slightly reddens litmus paper. The quantity of acid solution being thus determined for a known proportion of the size-solution, it is easy to ascertain by calculation the requisite amount for the whole of the size-solution to be decomposed. But a more convenient system for practical purposes is, to have a series of measures capable of containing the requisite amounts of the acidulous solution to neutralize the alkali present in one, two, three, or other number of gallons of the size-solution, so that the treatment is then reduced to an exceedingly simple form. In the practical manufacture of paper the following order or sequence of the applied substances, or treatment, is found to be the best, although the order may be varied more or less: The paper pulp being introduced in the sizing-engine, with the customary quantity of water, the necessary or determined quantity of size-solution is added, and at an interval of 20 minutes, more or less, and when the neutralization is complete, and the deposition of the resin thus economically accomplished, any alum which is to be applied, is added. This substance, for ordinary printing papers, is commonly added in the proportion of about two pounds' weight to each hundred weight of the pulp necessary for the manufacture of paper. The proportion varies, however, according to the required hardness of the surface of the paper, this hardening effect being the chief result due to the introduction of alum in the improved process. In some kinds of paper, alum may be entirely dispensed with in working out this process. This dispensing with alum applies more particularly to papers used by lithographers and engravers, for whose work alum is known to be prejudicial. After the addition of the materials to the pulp has taken place in the hereinbefore described order, the usual coloring matter is applied, and at this stage also, any fire-clay, or any other material, with which it may be desired to impregnate the paper.—*Practical Mechanics' Journal.*

IMPROVEMENTS IN TANNING LEATHER.

Wattles's Tanning Compound.—The claims of a patent recently issued to O. B. Wattles, of Waddington, N. H., is as follows:—

First, I claim the employment or use of soap combined with salt and lime, for unhairing or depilating the hides. Second, I claim the employment or use of soap combined with the tan liquor for tanning the hides, substantially as described.

The above process consists in the use of the ingredients specified in the claim for the purpose of softening the hide, improving its quality, and preventing the injurious effects which have hitherto resulted from the use of lime in unhairing. Mr. Wattles uses the soap, salt and lime in unhairing, and the soap and tanning liquors in tanning. The great study of all good tanners has

been to turn out the leather with little injury to the gelatine, of which it is largely composed. But their efforts have generally been fruitless. One of the best improvements, in this direction, was a patent granted for the use of potash in combination with lime and salt. In this process the potash robbed the skin of some of its gelatine, and formed soap. The quality of the leather thus produced, though better than that which the old mode permits, is still defective. Mr. Wattles claims to have discovered an improvement. The application of a special soap bath, while it cleanses out the lime, softens the skin and opens its pores for the reception of the tannin liquor, without in any way impairing the gelatine. The combination of soap with the tannin liquor also has an important effect in mollifying the latter, whereby green hides may be introduced without any danger of becoming hard. Indeed, the soap, by neutralizing undue acidity and opening the pores, causes the liquor to penetrate the skin, and unite quickly and thoroughly with the gelatine; the result being the production of a firm, pliable and superior quality of leather.

Enos's Improved Process.—The following is an extract from the specification of a patent granted to Roswell Enos, July, 1855, for tanning leather.

No new substances are employed, those which the patentee uses having been long known to tanners; he only employs them in a different manner from that which has been practiced heretofore:—

"The hair is first removed from the hides in any usual manner, and the hides thoroughly cleansed in either pure water or in a solution of salt and water. A batch of fifty sides are then placed in a liquor composed by steeping forty pounds of Sicily sumac, or one hundred and fifty pounds of unground native sumac, in two hundred and fifty gallons of water, and adding twenty-five pounds of salt thereto. The sides remain in said liquor from twelve to twenty-four hours—the length of time depending upon the temperature of the said liquor and the condition of the sides. About blood heat is the best temperature for the aforesaid liquor. After the sides have remained the aforesaid length of time in the salted infusion of sumac, the liquor is strengthened by adding thereto somewhere about two hundred gallons of strong oak or hemlock liquor, and fifteen pounds of salt, and the sides allowed to remain in this strengthened liquor for the space of from twelve to twenty-four hours. The sides should then be withdrawn, and placed in about the same quantity of a strong cold oak or hemlock liquor, containing twenty pounds of salt in solution, and allowed to remain in it for five or six days. They are then withdrawn and placed in the same quantity and quality of liquor—save that it should be of about blood-warm temperature, are allowed to remain therein five or six days, which latter operation should be repeated for six or seven times, when the side will generally be found to be completely tanned. While passing through each stage of this said tanning process the sides should be repeatedly handled, as all tanners are fully aware."

This is a description of the process. Practical tanners will perceive that neither acids nor alkalies are used for raising the hides, but that the salt sumac liquor is employed for the preparatory, and the common tan liquor for the finishing process. The inventor, an experienced tanner, says:—"The salt sumac liquor enters at once into the pores to the very heart of the sides, and

so acts upon them as to give them an exceedingly pliable yet firm basis, and so prepares them that the strongest liquors of oak or hemlock, &c., may afterward be applied without binding or injuring the hides."

We have been assured, says the editor of Hunt's *Merchant's Magazine*, that the sole leather made from this process, from sweated Buenos Ayres hides, will make sewed work equally as well as the limed slaughter hides. The leather is also tough and strong. The length of time required for tanning a dry Buenos Ayres hide is ninety days, with 75 per cent. gain. The time required for tanning an Oronoco hide is much less, with a gain of 80 or 85 per cent. This method will tan slaughter sole leather in thirty days: harness or upper leather in the rough in twenty days, and calf-skins in from six to twelve days.

MANUFACTURE OF GLUE FROM OLD LEATHER.

J. H. Johnson, of London, has obtained a patent for preparing old leather scraps to render them fit to be made into glue. The leather is first chopped into small pieces and thoroughly washed, then placed in vats where it is digested with a potash or soda. It is taken out, after a few hours, and subjected to pressure, and again immersed in a stronger alkaline solution for some hours, which processes remove all the tannic acid. It is now taken out and washed well with water, and submitted to a steep of a very weak sulphuric acid for twenty-four hours, to remove all the coloring matter. This being accomplished, it is again submitted to a weak alkaline solution of the carbonate of soda, then washed in water, and is fit to be made into glue by the common process.

ON THE ACTION OF GALLIC AND TANNIC ACIDS ON IRON AND ALUMINA MORDANTS.

Mr. Calvert, in a communication on the above subject to the British Association, drew the following conclusions:—1st. That there can be no doubt that tannic acid is the matter in tanning substances which produces black with iron mordants. 2ndly. That the reason of gallic producing no black dye is, that it reduces the peroxyd of iron in the mordant, forming a colorless and soluble gallate of protoxyd of iron. 3rdly. That gallic acid has the property of dissolving hydrate of alumina, and also of separating alumina mordants from the cloth on which they are fixed. 4thly. That the reason of extracts of tanning matter losing their dyeing properties is, that the tannin is transformed into gallic acid. 5thly. That gallic acid possesses the property of dissolving iron, and thus lays claim to the character of a true acid; while tannin, not having this action, appears to me to be in reality a neutral substance.

ECONOMIC APPLICATIONS OF BENZOLE.

English patents have recently been granted to Mr. F. C. Calvert for the employment of purified benzole, or coal naphtha, for the removal of paints,

oils, tar, grease, etc., from any variety of fabric, from leather, wool, for the cleaning of gloves, etc. For the above articles the benzole is employed by simple rubbing, and through its great volatility no mark or permanent odor remains on the substances treated. Mr. Calvert also applies benzole for the extraction of grease, oils, etc., from cotton-waste and rags used in wiping machinery. These substances are first saturated in a close vessel with the benzole, which is afterward pressed out, and subjected to distillation. The benzole distills over at a low temperature, but the grease and oils dissolved by it remain behind, and can be collected and used.

PHYSIOLOGICAL AND THERAPEUTIC EFFECTS OF CARBONIC ACID.

Some time since M. Herpin stated the following facts to the French Academy:—Dr. Struve took the Marienbad waters for a painful affection of the leg. He had been unable for several weeks to walk without a crutch. Dr. Struve had the notion one day of exposing his leg to the action of the carbonic acid which escapes freely from the spring at Marienbad, and forms a bed several diameters deep over its surface. After exposure for a while it produced a pricking sensation and warmth, which went on increasing till it occasioned a profuse perspiration of the diseased limb. Upon withdrawing his leg, he was surprised to feel no pain, and to find that he was able to walk without his crutch. He continued this treatment for some time, and has since experienced no return of his complaint. There are now in Germany special establishments for baths, douches, and the inhalation of carbonic acid. According to M. Herpin, the first effect of exposure to the gas is a sensation of pleasant heat, like that from a garment of fine wool, then a pricking, and afterward a burning which has been compared to that from mustard.

On the occasion of this communication, M. Boussingault related how he happened in 1826 to witness some of the effects mentioned by M. Herpin. He was visiting in the Quindin, New Granada, a part of the Cordillera, some *solfataras*, where numerous workmen were occupied melting and purifying sulphur. He encountered a crevice, whence issued abundantly a gas of the odor of sulphureted hydrogen. He attempted to descend in it in order to ascertain the temperature; but he had hardly entered the crevice when he felt a suffocating heat, which he estimated to be at 40° Centigrade, and a pricking in the eyes; respiration being difficult, he ascended quickly; his face was red, and his perspiration abundant. After a while he descended again with his thermometer, and was surprised to find a temperature of only 19½° Centigrade. The extreme temperature was 22° Centigrade. The gas was composed of 95 per cent. of carbonic acid, and 5 per cent. of atmospheric air and sulphureted hydrogen. It was hence the carbonic acid which caused the sensation of heat and the irritation of the eyes. At two other times, in 1827 and 1830, M. Boussingault experienced again the same sensations. He observed that the workmen who worked long in the solfataras of the Cordillera, in contact with carbonic acid, experience an enfeebling of the sight, and some of them become blind. Dr. Herpin confirms the fact with regard to the

action on the eyes of the baths of gascous carbonic acid. He observed that the douches of carbonic acid had been used against "*amblyopie*" or enfeebling of vision, and different precautions were used to moderate the effects of the gas, or diminishing the force of the jet, or its distance; or its direct action by interposing muslin. When the eyes have an inflammatory tendency, it irritates the organ and the neighboring parts; the heat sometimes produces dangerous congestion.

FOOD AND ITS ADULTERATIONS.

During the past year Dr. Hassall, of London, has published the results of the inquiry instituted by government respecting the adulterations of food—the investigations being conducted by a sanitary commission of which Dr. Hassall was a prominent member. The subject, from its very nature, says the *London Athenæum*, is one of no ordinary difficulty. The very first article on the list of substances examined is a proof. Coffee is found to be adulterated with chicory; but if persons prefer their coffee mixed with chicory, this can hardly be called an adulteration, even if it be a misnomer to call the compound coffee. We know a coffee-dealer who, wishing to avoid the imputation of adding chicory to his coffee, gave up the practice, when, to his great surprise, his coffee trade fell off to such an extent that his only alternative was shutting up shop or returning to his chicory. On adding chicory his trade again revived, and we see his name in Dr. Hassall's list as selling coffee "adulterated with chicory." To those, however, who prefer pure coffee it will be some consolation to know that the use of the microscope is a means by which this addition as well as many others can be detected.

Passing from coffee we come to sugar; and here it appears that little or no adulteration is practiced. A little mite, belonging to the same family as those which attack our figs, dates, cheese, and other kept food, is found in brown sugar, but not in lump. It is different with sweetmeats and *bonbons*. Children are really exposed to the swallowing of such trash, which sometimes proves fatal, in these compounds, that it would be a wise and safe rule to give them nothing but lump sugar in indulging their taste for this article of diet.

Arrowroot seems subjected to an adulteration in the shape of potato flour. This is a great fraud, for whereas genuine arrowroot costs one shilling or eighteenpence a pound, potato flour is not worth more than threepence or fourpence. The difference in form of the starch grains of potatoes and the arrowroot plants renders this fraud not difficult of detection. There is, however, one great comfort attendant upon this adulteration; and it is, that, so far as the ultimate action of potato starch on the system is concerned, it is precisely the same as arrowroot. This is not a poisonous adulteration.

Every one will naturally turn to bread as the staff of life, and inquire how much it is exposed to adulteration. With the exception of a little alum, in so small a quantity as to be questionable whether it is really pernicious, this important article of diet seems not to be exposed to any great amount of adulteration.

The reports on beer are not so full as could be wished, with one exception,

and that is on Allsop's bitter ale. The assertion of a French chemist that the strychnia, manufactured so largely in France, was used in England for adulterating bitter beer, put our brewers upon their mettle; and Mr. Allsop was the carliest to place specimens at the disposal of the chemist for analysis. As was to be expected, no strychnia was found in these ales, nor other kind of adulteration. The adulterations most frequently detected in London porter are salt and treacle.

From beer we turn to milk—and here nothing more deleterious than water could be discovered to have been added, and this only in eleven cases out of twenty-six.

Snuff in some instances was found to contain lead, and cases are cited where lead-colic and painter's palsy have been induced by the use of snuff. Pickles anchovies, spices, and preserves, were frequently found to contain injurious materials. On the whole, says the *Athenæum*, as the result of this inquiry, we have a higher notion of the morality of the trade than we had before. In by far the larger number of articles examined there was no adulteration. In another set of cases, the alleged adulteration, as in the case of chicory with coffee, is a matter of taste, and not of fraud. In another class of cases, and these a very large majority of the adulterations, the substances, though fraudulently added, were not injurious—as in the case of water with milk.

ON THE USE OF SALIVA.

The action of the saliva upon the starch we take as food, is similar to that of a ferment, and causes it to undergo a change into sugar. If you take a portion of pure starch and hold it in the mouth for only two minutes, you can obtain distinct and decided traces of sugar. We have here a solution of starch not treated with saliva, and if we cmploy our test for sugar, which you well know (sulphate of copper and liquor potassæ), we have no reduction of the oxyd of copper; but in this other mixture of starch and water, which has been held in the mouth for two minutes only, you may see distinctly a beautiful red line of reduced copper, the evidence of the presence of sugar. If the starch is left in the mouth for three minutes, a still more manifest action is apparent; and if it remains there five minutes, there is a distinct mass of reduced copper, which is proportioned to the quantity of sugar formed out of the starch. —*Bence Jones's Lecture.*

PREPARATION AND USE OF COFFEE.

From a report in the *Jour. Franklin Institute*, of a series of experiments instituted by Messrs. Dalson and Wetherill, of Philadelphia, we make the following extracts:—

In addition to the tannin contained in coffee, and which is somewhat altered during the process of roasting, the berry is characterized by two other substances; one caffein, a product containing nitrogen, which exists in the proportion of about one per cent. (the same exists in nearly a double proportion in tea), and is not altered in the roasting process; and the other a peculiar

volatile oil, developed during the roasting, existing in extremely minute quantity, and to which coffee owes its delicious flavor.

In this country a really good cup of coffee is the exception rather than the rule, and this may probably be attributed to the nation from which we are in a habit of selecting our cooks, since there is nothing in the whole culinary art which requires more "sense" than the preparation of good coffee. The experiments were instituted with a view of ascertaining whether a portable coffee, so simple in its operation that it can not be spoiled, could not be prepared for a price at least as low as that for which the raw or roasted material may be offered. This was only to be hoped for by extracting from the berry a larger amount of its nutritive substance than is done in the household, and in such proportion as would pay the expense of the operations to which it must be subjected. The attempt was not successful, yet some of the conclusions arrived at by the experiments are of interest

In respect to the most important part of the operation of making good coffee (the roasting), it is recommended that the roasting should take place in a cylinder, constantly turned over a bright fire; when a white smoke begins to issue from the joints of the cylinder, its contents must be carefully watched, and every few minutes a few grains extracted, and their color and brittleness examined. As soon as they break easily into several fragments by a slight blow, at which time the color will be a light chestnut brown, the operation is completed, and the coffee, if in large quantity, must be cooled, by taking portions up in a large tin cup, and letting them drop through the air. The quantity of aroma which might be supposed would be lost in this way is inconsiderable, and the danger of over-roasting, if the coffee is left in a heap, or covered up, is great. The coffee, both roasted and ground, may be kept in quantity without loss of flavor, if the vessel be corked air-tight. The best form of coffee-pot was found to be that which has an upper compartment, with a perforated bottom, upon which the coffee is placed, and the boiling water strained through. But in preparing the infusion in any way, both the coffee and the water should be measured in the proportion of a half an ounce in weight of coffee to a cupful of six fluid ounces of water, for each cup of the infusion. A small measure, containing somewhat less than an ounce of water, will hold half an ounce weight of ground coffee. It is important to keep the coffee-pot perfectly clean, as the least musty smell indicates a disagreeable taste, which is imparted to the coffee.

Experiments were made to ascertain whether the aroma lost in roasting coffee might not be collected advantageously. The volatile products generated in roasting were all carefully collected. Seven pounds of good Mocha coffee gave a little more than two ounces of dark liquid matters, possessing no very noticeable properties; and in no instance could any product be obtained of sufficient quantity or reaction to warrant any advantage in a practical point, of collecting the aroma. It appears in reality that but a small quantity of aroma is in reality lost by roasting, and what is dissipated is mingled with very disagreeably-smelling vapors, from which it would be difficult to free it. An experiment was also made to ascertain whether the fragrant volatile oils might not be driven from roasted coffee by steam, and a dried extract of the

residual coffee made, to which the same oils might be afterward added, giving a good portable coffee. This attempt was also unsuccessful.

It was next tried to obtain a portable coffee by making an aqueous extract of raw coffee, evaporating to dryness, and roasting the residue. An extract was obtained that, under some circumstances, gave good coffee, but as a whole the results were not satisfactory.

An experiment was also made to ascertain whether a very concentrated aqueous solution of coffee could not be made from ground roasted coffee by displacement with cold water, thus extracting more soluble matter than is done in the household, and at the same time obtaining a more portable coffee. A pound of ground roasted coffee was placed in each one of a series of five displacement apparatus, and river water poured through them, a pint at a time, using that which had run through the first to pour upon the second, and so on through the series. The coffee swelled, and each pound absorbed a quart of water during the swelling, which it did not suffer to drop, but which was displaced by fresh water. As soon as a quart and a half had been passed through one of the series, the absorbed liquid remaining in the coffee was pressed out by an hydraulic press of nine tons' power, and the droppings added to the following numbers in the series, which were treated in a similar way. By this means a very concentrated liquid was obtained. There were in all 24 pints of water added, and the resulting portions of coffee solution amounted altogether to about 18 pints, from which it follows that, notwithstanding the powerful pressure, the coffee residue retained six pints of water, or $1\frac{1}{5}$th its weight. When this coffee residue was dried, it was much lighter in color than ordinary coffee, and a cup of infusion, made in the ordinary way, had not the slightest flavor of coffee, and resembled in taste the decoction that one is served with in country taverns in the interior of Pennsylvania.

Those articles offered in the market under the name of "extract of coffee," and which profess to enable one by adding them to ground coffee to save in the preparation of the beverage, are all worthless and catch-pennies. They contain burned sugar, chickory, carrots, sometimes coffee, and other materials, and act only by giving a dark color to the infusion, and a peculiar taste, which misleads persons to think that the coffee made by their aid is stronger. The excellence of coffee as a beverage depends upon its caffein and a peculiar volatile oil, which are not contained in the above-mentioned additions. As early as 1782, one of these coffee essences was analyzed, and found to contain an alkaline carbonate; and it has been lately proposed to add carbonate of soda to the ground roasted berry in the proportion of 43 grains of the former to a pound of the latter, but it may be questioned whether this is a valuable addition, as Böhmes observed that a small quantity was useless, while a larger quantity communicated an unpleasant taste to the coffee.—*Journal Franklin Institute.*

CURIOUS CHEMICAL CHANGES OBSERVED IN CERTAIN WATERS.

The following paper was recently communicated to the Boston Society of Natural History, by Dr. A. A. Hayes:

Last autumn I received a parcel of "efflorescences," from the soil of the desert, between the head waters of the Missouri River, bordering on the eastern flank of the Rocky Mountains, from Lieutenant Grover, U. S. A., who conducted a party engaged in a reconnoissance of that region. The earth, of many square miles of surface, is covered by a gray saline frosting, which exists so abundantly that vegetation does not appear, and the features of sterility are so widely displayed as to cause a true desert. Chemical analysis proved the efflorescence to be sulphate of soda, with minute traces of sulphate of lime and common salt, mixed with fine sand, to which the gray color was due; no other saline compound was present. The sulphate of soda was nearly anhydrous, being, in fact, thenardite, but evidently formed from a hydrous salt by desiccation. No distinct crystals were included in the specimen received. The occurrence of this salt, as an abundant exudation from the soil, is interesting in a mineralogical view; and its presence, under the form of an efflorescence, illustrates the physical law, in accordance with which saline waters rise through the soil, and in evaporating from the surface, leave their saline parts at that point, thus forming deserts. It has been long known to me that the water of the Missouri River contains sulphate of soda, and the presence of this salt in the water occasions a change in the composition of the water of the Mississippi River, after these waters become mixed, below St. Louis.

The water of the upper Mississippi contains a large amount of organic matter, of a kind which in changing its composition, out of contact with air, attracts oxygen powerfully, and will decompose oxydized bodies. The dark color of the buried salt is due to the presence of sulphuret of iron, formed from the oxyd of iron of an ocherous clay, reduced and rendered a sulphate of iron, by the presence of sulphates of soda and lime in the water. So abundant is this organic matter, that the silt of the Mississippi water, after having been kept ten years, has the power of decomposing alkaline sulphates, and forming the sulphate of iron with the sulphur of the sulphate, while the soda, in presence of carbonate of lime and carbonic acid, is eliminated as a sesqui or bicarbonate of soda. Below St. Louis the turbid water of the Mississippi contains, as its characteristic salt, the bicarbonate of soda; and its suspended matter being deposited by rest, we always find in the clear water this alkaline salt, constituting a large part of the whole saline matter. I have been able to trace the steps of the production of the bicarbonate of soda from the sulphate of soda, by the silt of this river in my vessels. The sulphate of iron, also produced at the same time, oxydizes in free air, becoming oxyd of iron and free sulphur. Sulphates are not the final result of the oxydation of basic sulphates usually. The clay-colored cliffs and banks of the Mississippi exhibit the oxydized state of the small portion of iron oxyd, one of its constituents, while the dark, and even black, color of the buried mass beneath the surface, is due to the reduced, and generally sulphureted, state of the iron, a condition caused by the changing organic matter. Until the discovery of the existence of sulphate of soda in the soil washed by the tributaries of the Mississippi, its origin in the water was a subject of doubt, and in this connection the new fact becomes important. Regarding the immense body of water discharged by the Mississippi, as a diluted solution of bicarbonate of soda, which falls

into a warm ocean containing lime salts, easily decomposed by the soda salts, we have chemical action on an extended scale. The result of this action must be some form or forms of carbonate of lime, fitted either for the habitations of shell-building fish, or for consolidating calcareous rocks.

Returning to the first exhibition of chemical change, we see the influence of the minute quantity of organic matter dissolved in the water—a constituent so small in weight that it has been generally neglected in the analysis of waters—and yet, under favorable circumstances, becoming a sufficient cause in bounding a coast line with cliffs, or even producing a rock formation.

As the facts cited might be considered an unusual occurrence, favored by certain local causes, Dr. Hayes in a subsequent paper referred to another instance where, from similar changes, the water flowing below the surface, and constituting the drainage of the country, is largely composed of a solution of the bicarbonate of soda.

The subterranean waters of the peninsular of Boston, have at the depth of about 140 feet, a remarkable uniformity of composition, and the flow toward the shore line is abundant. Like the water of the lower Mississippi, they are turbid, holding in suspension finely divided carbonate of lime and iron, and hydrate of silicic acid; affording, when greatly heated, a precipitation of hydrated carbonate of lime, due to the instantaneous decomposition of sulphate of lime, by a solution of bicarbonate of soda present. The latter salt is in these cases always in excess; so that the whole mass of the drainage, at about the same level, has a marked alkalinity, and belongs to the class of alkaline waters.

Numerous observations have shown that this water is covered by a compact marl-earth, which has so large a proportion of clay that it effectually divides the upper drainage from the lower, or alkaline water, which, from its depth below the surface, can enter the harbor water only at some distance from the shore. When attempts have been made by continuous pumping for many days, to exhaust the supply, or overcome the flow of the water at one point, the wells or borings at contiguous points have shown a reduction of volume in the water; but a reflux of the ocean water through the same channels has been effected only where, after several days, a very large volume of water had been pumped from one opening. This fact establishes our knowledge of a continuous flow of alkaline water toward the sea from the shore line, while the depth of the stratum under which it flows, shows that it is overlaid by the mass of sea-water near the shore. A continuation of solid marl stratum below the water near the shore, would prevent any intermixture of the alkaline water with the sea-water at that point, and allow it to gradually mix only when the soundings are about twenty-five fathoms. There is no cause apparent, which would prevent a continued suspension of the minutely divided matter, until the turbid water mixes with the sea-water. In the cases of pumping referred to, the water, after some days, became more turbid than at the commencement of the trials, leading to the conclusion that turbid water occupied every part of the submarine channels of flow.

Proceeding to the more distant sources of this water, I have resorted to chemical analyses of the waters from various points in the vicinity of Boston,

and the evidence that this water enters the strata in the country back from the neighboring city of Charlestown, is almost conclusive. Many of the open wells of that city contain a clear water, having bicarbonate of soda in excess over the earthy salts also contained in it, and I have found that the argillite and clay beds contain sulphates of lime and soda, as well as silicates of soda and potash.

The occurrence of fresh water forced up from below the ocean, along the border of our Southern States, has been frequently described. I have observed phenomena in several places among the West India Islands, illustrating this flow from the land under the water of the ocean, where the elevation of volcanic mountains was considerable.

The mere presence of fresh water at the bottom of the ocean infiltrating through the slime, or sand, would be sufficient to induce chemical changes by the disturbance of electrical relations. While the surface and mass of the ocean water, absorbing oxygen from the air, would be positive to a stratum of sea-water mixed with fresh at the bottom, decompositions of oxydized bodies with simpler forms of matter would take place near the line where they blended. I am disposed to consider the presence of organic matter, either carried in solution from the land, or taken up from the salt and stirred by the fresh water, as the more active cause of decomposition of oxydized bodies. The formation of the sulphurets of metals, from metallic masses, which have been deposited at the bottom of the sea, on soundings, is more simply explained by this mode of action also. The existence of a drainage flow of turbid water, or a water containing bicarbonates of alkalies, or alkaline earths, along a coast line, would account for the green color of sea-water on soundings near coasts. The division of blue water into many thin portions between reflecting surfaces, produced by the presence of suspended solid particles, alters its color to the hue which, by contrast, is called green. These solid, though finely divided particles, would be far more abundant in the case of the flow of alkaline waters, for the mixing of such waters with the ocean would be followed by the constant decomposition of the lime salts of the ocean water, and the production of carbonate of lime in a hydrous, gelatinous form, passing into the state of opaque particles, and precipitating continuously. A natural cause for the production of carbonate of lime, by precipitation from the lime salts held in solution by sea-water, is thus acting along the coast line of this and probably other countries. The influence of the minute quantity of organic matter contained in drainage water in producing chemical changes of importance is rendered apparent, in this connection, by its power of decomposition of oxygen sources.

Professor W. B. Rogers remarked that the fact of the entire deoxydation of sulphuric acid on a great scale in nature was well exemplified in the tertiary clays and sands of extensive districts in the marl region of Virginia. Some of these deposits contain, even now, so much free, or only partially neutralized, sulphuric acid as to impart to the mass a strong acid flavor and reaction. The shells originally imbedded in them having been entirely removed by the solvent action of the acid, have left in the clay and sand innumerable hollow casts, beautifully impressed with the external markings

of the fossils, while the sulphate of lime formed by this reaction has been accumulated often in large groups of selenite crystals in the lower and comparatively impervious layers. In many cases, the residuary sulphuric acid, in the presence of much diffused organic matter, has been wholly deprived of its oxygen, and reduced to the condition of sulphur, so that, over wide areas, these ancient, and now effete marl beds, exhale a sulphurous odor, and yield a sensible amount of sulphur when exposed to heat in a close vessel.

Professor Rogers then referred to the acid and alkaline springs of the slate formations of the Appalachian belt, as depending on the development and reactions of sulphuric acid. The former class of springs, always containing an excess of this acid, along with earthy and other sulphates, were observed to originate in belts of slaty rock, containing no carbonate of lime, either diffused or in the shape of interpolated layers. The latter issued from slates rendered more or less calcareous by the presence of fossil shells and plates of limestone. The sulphuric acid evolved by the oxydation of the iron pyrites abounding in both these varieties of slate remained, in the former case, in part uncarbonized. and was carried off by the waters of the so-called *Alum Springs;* but in the calcareous slates the effect was different. Here, reacting with the carbonate of lime, it became neutralized, and, at the same time, set free an immense amount of carbonic acid. This agent, favored probably by pressure due to depth, as well as by relative quantity, dissolved out a portion of the carbonates of lime and magnesia of the slates, and by reacting on the salts of soda, always present, formed the carbonate of that base. The percolating water thus became impregnated with earthy and alkaline carbonates, and with an unusual amount of silica due to the solvent action of the latter, and in this way, as he conceived, were formed the well-known *alkaline springs* of these slate regions.

OBJECT OF SALT IN THE SEA.

Professor Chapman, University College, Toronto, has published an interesting paper on the object of sea-water being salt, and after giving his objections to the usually received opinions, he urges the theory that the object is to regulate evaporation. If any temporary cause renders the amount of saline matter in the sea above its normal value, evaporation goes on more and more slowly. If this value be depreciated by the addition of fresh water in undue excess, the evaporating power is the more and more increased. He gives the results of various experiments in reference to evaporation on weighed quantities of ordinary rain-water, and water holding in solution 2·6 per cent. of salt. The excess of loss of the rain water compared with the salt solution was, for the first twenty-four hours, 0·54 per cent.; at the close of forty-eight hours, 1·04 per cent.; after seventy-two hours, 1·46 per cent., and so on in increasing ratio.

APPLICABILITY OF GELATINE PAPER FOR COLORING LIGHT.

This material was invented in 1829, but up to the present time has not been successfully applied to any more useful purposes than the manufacture of ar-

tificial flowers, address cards, tracing paper, wafers, etc. It is commonly manufactured in sheets, measuring 22 inches in length by 16 in breadth, which are sold at a small price; but sheets can be easily made of any dimensions not exceeding those of which plate-glass is capable. It can also be made of any thickness from the finest tissue upward. It may be obtained as transparent as the best glass, and more free from color, or of all colors and shades, without interfering with its transparency. It is exceedingly light, and may be bent or rolled up without injury. It can be cut with the scissors like ordinary paper, and may be easily stitched with a needle and thread. By means of an aqueous solution of gelatine, it can be made to adhere accurately to plates of glass, without any interference with its transparency. When varnished with collodion, it becomes perfectly water-proof, more pliable, capable of bearing a considerable degree of heat without injury, and its transparency is not affected. Hence it appears that gelatine paper, in addition to its transparency and susceptibility to various colors and forms, is cheap, portable, and durable. Such being the properties of the material, Mr. Dobell suggests its employment for various purposes, and especially for preserving and benefiting the sight, for which it may be used as follows:—A small sheet of very pale green or blue gelatine paper may be used in reading. The sheet is simply to be laid upon the page of the book, and the light conducted through the colored medium. If used in a faint light, the reading paper is to be raised a little from the book to admit more light beneath it. A sheet of gelatine paper may be set in a light frame, and placed like a screen before the window, or lamp of the engraver, the watchmaker, etc.; thus providing a light of genial color in which they may pursue their occupations. Similar appliances may also be used by needle-women. For this purpose screens are to be provided, both of green and blue gelatine paper; so that the white materials employed in needle-work may be changed to a pleasant green, by the screen of that color, the yellow materials to a green by a blue screen, and by one or the other of these screens the reds softened down into violets or browns. For either of the two last purposes on a larger scale, the gelatine paper may be attached to the window-glass of the apartment, thus coloring, if necessary, all the light admitted during daylight. Shades for the eyes, in certain affections of the sight, may be made of gelatine paper, to take the place of the green or the blue silk, or card shades, worn by many persons. The gelatine paper, being transparent, will allow the wearer to see his way about, at the same time that the eyes are protected from glaring light. This may be especially useful in cases where it is desired not only to shade a diseased eye, but also to protect its nerves from strong light admitted by the sound eye. Masks of gelatine paper may also be used for protecting the eyes of travelers against the glare of snow-fields and of sandy deserts.—*Lon. Edin. and Dub. Phil. Journal.*

ON THE PREPARATION OF ROUGE AS A POLISHING POWDER.

To get the employment of oxyd of iron obtained by the calcination of protoxalate of iron in preference to the lixiviated colcothar as a polishing

powder for optical glasses, metals, etc. At the present price of sulphate of iron and oxalic acid, it may be prepared for about five shillings per pound. —*Buchner's News Report.*

ON HYDRAULIC LIME, ARTIFICIAL STONES, AND SOME NEW APPLICATIONS OF THE SOLUBLE ALKALINE SILICATES.

M. Kuhlmann, in a recent communication to the French Academy presented some interesting facts respecting the hydraulic limes, artificial stones, etc. His examinations show that all limestones, especially the hydraulic limes and natural cements, contain notable quantities of potash and soda. The part which these alkalies serve, is to bring the silica to the lime, forming silicates which, in contact with water, pass into a state of hydratation similar to that of gypsum. A fat lime may be immediately transformed into an hydraulic lime by simple contact with a solution of silicate of potash. If after the burning of the limestone, potash be in contact with the silica, the silicate which is formed must necessarily react; but this can not occur until the lime is brought into contact with water. If fat lime and an alkaline silicate, both in fine powder, be mixed in the proportion of ten or twelve of the silicates to 100 of lime, a lime can be obtained which presents all the characters of an hydraulic lime. If the ingredients were not finely powdered the reaction would be incomplete, and after the solidification, a disintegration of the mass would take place. This affords the means of constructing, at moderate expense, buildings to resist the action of water, where none but fat limes are found. By mixing powdered chalk with a solution of silicate of potash, a cement is obtained which hardens slowly in the air, and becomes sufficiently hard to be applicable under certain circumstances, for the restoration of public monuments, the manufacture of molded objects, etc., etc. Chalk, whether in an artificial paste, or in its natural state, if plunged into a solution of silicate of potash, absorbs even in the cold, a quantity of silica, which may be increased to a considerable extent by exposing of the stone alternately, and for many times to the action of the solution and of air. The chalk assumes a smooth appearance, a compact grain, and more or less of a yellowish color, according as it is more or less impregnated with iron. Stones thus prepared are susceptible of receiving a high polish. The hardness which at first is but superficial, penetrates by degrees into the center, even when the stones are of considerable thickness. They appear susceptible of undoubted utility in the formation of works of sculpture and various ornaments, even those of the most delicate workmanship; for where the silicatization has been effected on well-dried chalk, which is essential for the production of the best results, the surface remains unaltered. Some attempts have been made to apply these stones for lithography which promise success.

This method of converting soft limestone into silicious limestone may become of great value in the art of building. Ornaments unaffected by damp and of great hardness may thus be obtained at little cost, and in many cases a plaster made with a solution of silicate of potash will preserve from decay ancient monuments formed of soft limestone.

M. Kuhlmann in the course of his investigations has submitted the silicified stones to a true process of dyeing, by impregnating them in the first instance with certain metallic salts, which by precipitation would produce the required color. Thus by impregnating the stones with salts of lead or copper, and then exposing them to sulphureted hydrogen gas, or a solution of sulphuret of ammonium, he obtained at pleasure different shades of gray, black, or brown. With the salts of copper and ferrocyanide of potassium, I obtained a copper color, etc. In this connection was observed a fact, which in a theoretical as well as practical point of view, is not without interest. M. Kuhlmann found that porous limestones, and all other bodies of similar composition, when boiled in a solution of a metallic sulphate, the base of which is insoluble in water, gives rise to the disengagement of carbonic acid, and the fixing to a considerable depth of the metallic oxyd in intimate combination with sulphate of lime. When the metallic sulphates contain colored oxyds, we thus obtain very beautiful tints of different colors. Thus with sulphate of iron we get a rusty color, more or less deep, according to the degree of concentration of the solution. Sulphate of copper gives a beautiful green color; sulphate of manganese a brown; and a mixture of sulphates of iron and copper, a chocolate. The affinities which determine these reactions must be very powerful for the metallic oxyds of the sulphates to be so completely absorbed by the carbonate of lime, that with some oxyds, such as that of copper, there remains not in the solution, after boiling in, with excess of chalk, a trace appreciable by the most delicate tests. In this way corals and shells may be colored with a great variety of tints.—*Comptes Rendus.*

Another step taken by M. Kuhlmann was the application of alkaline silicates, to painting; and instead of oils and the ordinary vehicles, he uses a concentrated solution of silicate of potash, finding it to work well with vermilion, ultramarine-blue, the ochres, oxyd of chrome, and some others. These colors applied to a wall become, so to speak, part of its substance and almost imperishable. Prepare your wall, paint it of any color, then sprinkle the whole surface with a solution of silicate of potash, or soda, and you cover it with a permanent glaze. Advantage has been taken of this discovery in the decoration of public buildings in Germany, with the happiest effects.

Wood, affected as it is by moisture, is not so well adapted for the silicated colors as brick or stone. The most suitable kinds, according to M. Kuhlmann, are ash and horn-beam. But glass, porcelain, and metal, if quite dry, take the colors readily. In glass particularly, a semi-transparency is obtained, which renders it applicable, at low cost, to the windows of private houses or of churches; and we all know what admirable effects can be produced by colored panes artistically introduced. At this point the author makes the following practical remarks: "Artificial sulphate of baryta, applied by means of the silicate of potash to glass, gives to the latter a milk-white color of great beauty. The sulphate becomes intimately incorporated with the silex, and after a few days can not be washed off even with hot water. On subjecting the glass thus painted to the action of an elevated temperature a beautiful white enamel is produced on the surface, which would economically replace the enamels that have oxyd of tin for their base. Ultramarine-blue, oxyd of

chrome, and colored or porphyrized enamels, are a great resource in this new method of painting, for if there be no chemical combination in all these applications of color, there is at least a very powerful adherence determined by the silicious cement, of which the hardening is doubtless facilitated by the excessive division wherewith it is presented to the action of the air."

M. Kuhlmann has further succeeded in using his silicated colors for designs on paper-hangings, on cotten and woolen cloth, and in letter-press printing. "The processes," he says, "differ very little from those in use in the various modes of printing. One important condition is to maintain the silicious colors in a uniform state of humidity during their application, whether the application take place with blocks of wood or metal, or by having recourse to type. All the colors that I have applied," he adds, "on stone, wood, metal, or glass, serve for printing on paper or woven cloths. Typography, color-printing, the application of gold or silver in powder or in leaf, can all be executed with the same facility, taking care, with certain colors, to keep out sulphur in the preparation of the silicates. Ultramarine is fixed in cloths with more solidity and economy by the silicate of potash than by the methods now in use."

Here we have a wide range of applications arising out of M. Kulhmann's discovery, and that the range will be extended is not doubtful. We may add that by grinding the charcoal used in the preparation of Indian-ink with silicate of potash in solution, a writing-ink is obtained almost indestructible by chemical agents; and the same solution, mixed with a decoction of cochineal, gives a red ink, the color of which resists for a long time the action of chlorine and the acids.

New Cements.—A cement recently patented by Captain Scott, R. A., Woolwich, England, is prepared by mixing quicklime and carbonate of lime in such proportions as enable them to form, when properly treated, a subcarbonate. These substances are then to be reduced to a powder, and mixed with hot or cold water, and can be used as mortar or for molding purposes.

Another English patent has been used during the past year for making a cement, by calcining charcoal with chalk and the oxyd of zinc. After being well calcined in a proper kiln these materials are suffered to cool, then ground to powder, and in that state are fit to be mixed with water and make a good cement.

NEW PLASTIC COMPOUND FOR USEFUL AND ORNAMENTAL PURPOSES.

The following is the description of an invention, for which patents have recently been obtained, by J. H. Scoutetten, of Metz, France. It refers to the manufacture of a paste, composed of vegetable and mineral substances, the number and quantity of which varies according to the purpose for which the paste is required. Thus gutta-percha, caoutchouc, pitch, resin, wax, gum-lac, oxyd of iron, golden sulphuret of antimony, ultramarine, chrome, zinc white, etc., may be used.

Manufacture of the Paste.—A steam engine serves to furnish steam to two superposed hollow cylinders. These cylinders are themselves moved by the steam.

crush the substances which enter into the composition of the paste, and form a homogeneous mass. Double-bottomed cauldrons, equally heated by steam, receive the matter, which, according to circumstances, may be heated dry or in hot water. When paste is made it is put into molds and compressed, in order to produce the objects required. These molds are composed of gutta-percha, containing a twentieth part of caoutchouc; this process of molding affords results hitherto unknown. Each mold should be bound with iron. This paste may also be composed chemically. In this case the gutta-percha, caoutchouc, and pitch, are dissolved in the sulphuret of carbon. When the solution is complete and the combination well effected, the solution is purified, the sulphuret of carbon is drawn off, and a mass is obtained which may be heated dry in close vessels. If it be desired to make pipes, boot-soles, straps, etc., add to the above substances, held in solution in the sulphuret of carbon, carded cotton, all the portions of which are penetrated or exactly coated with the material. It is then purified, as in the former case, and a mass is obtained which is heated dry and passed under rollers. Under other circumstances, and according to known processes, the cotton is replaced by linen, canvas, silk, wool, or any other textile substance. The paste, thus prepared, may be colored by adding one or more of the oxyds indicated. When it is desired to render paper or stuffs impermeable, the caoutchouc and the gutta-percha must be separately dissolved in sulphuret of carbon, in the proportion of 8 of gutta-percha to 100 of sulphuret of carbon, well purified. The solution is left to rest during 8 days, and the white of eggs is added to it. When the impure matters are deposited, it is poured forth to obtain an almost colorless liquid. Paper or stuff may be then steeped in this liquid, and drawn from it by passing the fabric between cleansing rollers, which equalizes the layer of the matter. These stuffs become fit for all impermeable clothing. The paper, rendered impermeable, is suitable for photography; it is a substitute for parchment; and it serves for the preservation of valuable papers, to prevent their falsification, erasures, and the action of chemical agents. As to the applications of the paste, they are innumerable; they comprise a complete molding material, either for objects of art or utility; and in many cases may replace leather, pasteboard, plaster, carvings in wood, etc. The objects may be bronzed, gilt, or silvered.

Wood's Artificial Stone.—A patent has been recently granted to John Wood, of Brooklyn, N. Y., for an artificial stone, prepared in the following manner:—The proportions are fifteen parts clean sand, five parts calcined plaster, and four parts animal blood. When first mixed, the composition is about the consistency of stiff mortar, and the most fragile plaster mold is sufficient for its retention during the few hours necessary to the perfection of its form.

The chemical action of this mixture has been described by Professor Mapes, as follows:—The potash of the blood dissolves a portion of the sand, and diffuses it throughout the mass as *silicate of potash*, the element to which all material analogous to this owes its adhesive properties. The *albumen* of the blood becoming thoroughly commingled by manipulation, is coagulated by the silicate of potash, and rendered insoluble—thus forming locks holding all the

parts firmly together, while the iron of the blood forms a sesqui-oxyd, and still further cements the mass. The union of silex and alkali alone produces, in some cases, a very high degree of hardness, as in the case with feldspar, and in this composition are fulfilled all the conditions of a perfect stone, no element except time being wanted to insure its extreme hardness, strength, and ability to resist the action of the elements. The uses for which this artificial compound seems especially adapted are statues and architectural ornaments, as it may be molded with the same facility as plaster, and gradually hardens into a perfect and unchangeable stone. It resembles red sandstone in color, but may be painted and sanded to conform to any tint desired.

Artificial Coral.—Mr. S. Isaacs, of London, has taken out a patent for making artificial coral, by causing alabaster to be impregnated with oil containing red coloring matter, such as madder, after the alabaster has been treated with a very weak solution of sulphuric acid.

TURKISH RECIPE FOR HYDRAULIC MORTARS AND CEMENTS.

As the aqueducts of Constantinople are attracting additional notice the more they are studied and examined, being astonishing works (especially if we take into account the infant state of chemical and mechanical science among the Turks), the following recipe will be found of interest, and deserving examination and trial. It is, moreover, a curious fact that other semi-barbarous nations, also, are in the possession of mechanical procedures and contrivances, inaccessible even to European science and art; as, for instance, the art of the Chinese to unite (solder) cast iron, etc.

Lime Mortar is prepared with fresh water, and mixed with two parts of powdered lime, and one part of river sand.

Hydraulic Mortar.—Bricks are pounded until the grains attain the size of common river sand, and one part of the brick powder is mixed with two parts powdered lime, and the necessary quantity of fresh water. In using this mortar, a layer of mortar is placed between the bricks or courses of bricks of the same thickness of the brick, which must have been previously soaked in water. This latter treatment is never neglected.

Hydraulic Cement for the internal dressing of arched aqueducts, cisterns, and all constructions through which water flows, or is contained. Take 100 *ockas* (of 2¼ lbs. of 16 ounces) of fluid lime, and twenty-four ockas of very minutely plucked tow, which is to be distributed very accurately throughout the mass. If these two ingredients have been duly mixed and worked up, the mass thus obtained has to remain quiet during at least eight days, that the tow may have time to combine thoroughly with the lime. If the mortar is to be used, it is to be again well stirred up, and is to be spread with a small trowel. For the sake of protecting it still more from the action of water, and to make it durable for a long time, it is then to be coated with a putty which is called *lukin*, and is thus prepared:—To 100 ockas of freshly-burnt lime, which has been converted into dust, 25 ockas of the best linseed oil are added, as well as 20 drachms of rough cotton. The lime is to be worked or mixed in a wooden chest or trough, while the linseed oil and

cotton are added in succession, until the mass has attained the consistency of dough. This mass is preserved in large pieces resembling loaves of bread. If it is to be used, it is stirred up with linseed oil until it becomes fluid, and fit to make a coating, which is painted over twice or thrice. Cements so prepared and allowed to dry, acquire the hardness of stone, resist all moisture, and possess an indestructible durability.

ACTION OF SEA-WATER ON CEMENTS.

M. Vicat states in a communication to the French Academy, that he has determined as the result of his experiments, that sea-water will destroy every cement, mortar, or puozzolana, if it can penetrate into the mass immersed in it. As, however, certain of these compounds are perfectly durable when constantly immersed in sea-water, they can not have been penetrated by it. Its penetration has been prevented by the surfaces, and the power of this inability to penetrate is chiefly caused by a superficial coating of carbonate of lime which has formed either anteriorly or posteriorly to their immersion, and which in time augments in thickness. The effect of a kind of cementation produced by the decomposition of the sulphate of magnesia, of the sea-water and the deposition of carbonate of magnesia, in the superficial tissue of the mass, and the formation of incrustations and submarine vegetation, contributes also to this impermeability. But all such superficial impermeable coatings are not attached with the same force to the mass which they envelop. The differences which have been observed in this respect depend in some cases upon the chemical constitution and upon the peculiar cohesion of the silicates, and in others upon their submarine situation, relative to the action upon the waves and the rolling and dashing of shingle upon them. Hence the differences which have been observed by engineers in the durability of concretes of which such silicates form the gange.—*Comptes Rendus*, Jan. 1854.

ON THE PRODUCTION OF ALCOHOL FROM BICARBURETED HYDROGEN.

The following account of this most important chemical discovery of the year is taken from the proceedings of the French Academy:

When the chemist exerts his skill on materials of organic origin, he extracts a series of substances, each proceeding from the other, whose composition becomes more and more simple, until it reaches some species known to mineral chemistry. Vegetable economy constantly realizes under our eyes the inverse operation; it takes in air, water, and mineral elements which it assimilates, and, in virtue of certain of its own forces, disposes them in molecular groups of a certain stability. It would appear as probable that these forces are inherent to the exercise of life; nevertheless it may be conceived that before the constant challenge given by the "subtlety of nature" to the "subtlety of sense and intellect," science should endeavor to imitate nature, and try to ascend in the series of combinations from the simplest to the composite.

Chemists know that by following an accustomed routine, alcohol (an organic substance) may be decomposed into two simpler compounds, viz., water, and bicarbureted hydrogen. The plan is as follows: alcohol is placed in a retort, with a portion of concentrated sulphuric acid. On the application of heat, carbureted hydrogen gas is liberated, which burns with great brilliancy, while steam and a measure of water is left behind. The inverse operation to this would consist in uniting the bicarbureted hydrogen and water in such proportions as to form alcohol. This, and other like operations, chemists have deemed impossible. It was the problem which M. Berthelot, of France, proposed to himself, and which has resulted in a complete solution. The point which is, perhaps, the most remarkable of the process, is that the solution is grounded on the use of the same body which hitherto has served to effect the decomposition of alcohol. The same sulphuric acid which at 160 degrees Centigrade acts to separate water from the carbureted hydrogen acts altogether differently at the ordinary temperature; in contact with the gaseous body it gradually absorbs and disposes it to re-enter into combination.

This is the plan followed by M. Berthelot in his experiments: Having prepared about thirty quarts of bicarbureted hydrogen, he placed them in a close retort with 900 grammes of pure and highly concentrated sulphuric acid. To this was added five or six volumes of water. The whole was then submitted to successive distillations, carbonate of potash being used to retain the water. In the last condenser, M. Berthelot found 52 grammes of an alcoholic liquid, corresponding to 45 grammes of absolute alcohol, and three fourths of the gas employed; the remainder was lost in the manipulations. This alcohol possessed all the properties of ordinary alcohol; the same taste and odor, the same point of ebullition, the same inflammability at the approach of a body in combustion, and the same colored flame; it had, too, the same dissolving power and the same reaction on all bodies—it was indeed regenerated alcohol. The bicarbureted hydrogen used by M. Berthelot was obtained from the decomposition of alcohol; he made also other experiments with bicarbureted hydrogen found in common illuminating gas, and obtained the same result. In this case, then, beyond a doubt chemistry has succeeded in making and unmaking the same composition of organic origin, and (perhaps the curious point) it was made in both instances by the same reagent, by a mere change of temperature. M. Berthelot had already obtained analogous results by operating on the products resulting from the decomposition of oleaginous substances. By placing these products together and letting them act slowly at a suitable temperature, he succeeded not only in regenerating the natural fats, but associating these products of decomposition in different manners, he succeeded in forming bodies analogous to the fats which are naturally formed. What can be concluded from these different examples, but that after being successful in transforming a composite substance into two others, the chemist has always a right to hope he may be able to reunite them and remake that which gave them birth. In any event success would be an interesting fact for science, and besides such a fact would give rise to important applications. Thus when dilute sulphuric acid is allowed to act upon cane sugar, the latter is converted into glucose, or the sugar of grapes—the grape sugar taking an

additional equivalent of water. If now we could effect the inverse reaction, grape sugar would be transformed into cane sugar, and as the former can easily be obtained from woody fiber or starch, the inverse process would enable us to transform sawdust into cane sugar, or table sugar.

M. Bertholet has moreover submitted his experiments to another carburet of hydrogen—"propylene." Submitted to the action of sulphuric acid, and to successive distillations, it gave a spirituous liquor which presents the most striking analogy with ordinary alcohol, and which from this quasi-identity has been called propylic alcohol.

According to Marx, this discovery, put forward by Berthelot, was made twenty-seven years ago by Hennel, who, in the *Philosophical Transactions* for 1828, p. 365, says: "By combining olefiant gas with sulphuric acid, we may form sulphovinic acid, from which we may obtain at pleasure, by varying the circumstances of decomposition, either alcohol or ether." The method of performing this experiment now recommended is to pass common coal gas through sulphuric acid, and then to add water in excess.

ACTION OF ALCOHOL UPON THE STOMACH.

The following facts respecting the action of alcohol upon the stomach and tissues, communicated by Dr. A. A. Hayes of Boston, are somewhat different from the generally-received opinions on this subject:

Undiluted alcohol consists of 4 equivalents of carbon, 6 of hydrogen, and 2 of oxygen. This substance in its undiluted state, introduced into the stomach, causes death, and is ranked by toxicologists among the narcoto-acrid poisons. In a diluted state, mixed with from one to eight times its volume of water, it represents the active principles of nearly all the alcoholic liquors. Leaving out of view the volatile aromatic oils, the sugar, the vegetable matter, etc., of the distilled and fermented liquors, we have to consider the mixed vapor of alcohol and water, exhaling in the body at the temperature of 98° Fahrenheit. This vapor, when it comes in contact with oxygen, either as a gas or dissolved in fluids, undergoes a rapid change, resulting in the formation of aldehyde, which consists of 4 equivalents of carbon, 4 of hydrogen, and 2 of oxygen.

This substance is the uniform product of the exposure of the mixed vapor of alcohol and water, in contact with extended and porous surfaces, to the smallest quantity of oxygen the alcoholic vapor can combine with at 98° Fahrenheit.

The evidence of its production in the system obtained by Ducheck and others, is sustained by appropriate chemical experiments. As alcohol corrugates the tissues and coagulates the blood, it does not probably pass into the circulation (and in experiments which seem to show its existence in the blood, etc., aldehyde was probably mistaken for alcohol, which it very nearly resembles). Aldehyde boils at 71° Fahrenheit, and therefore exists in the system only as a vapor, capable, if restrained, of exerting a high tension. Its affinity for oxygen is very strong, and by the union of one of its equivalents of hydrogen with oxygen, water is formed, and the substance is changed to acetous acid. Probably the oxydation is carried one step further in the body,

and acetic acid is formed. The heat produced by the combination of oxygen with the hydrogen of alcoholic vapor is not a new quantity gained from a special food for respiration, but it is heat *from one source substituted for the heat which would have been obtained* from another source.

Alcohol, in changing into aldehyde, abstracts oxygen from the system. The result of this is an increased respiration to restore the oxygen thus taken away, and an apparent increase of heat. The action of alcohol in the system, so long as it remains alcohol, is to excite and stimulate; afterward, as aldehyde, it acts as an anæsthetic.

AMMONIA AND NITRIC ACID IN RAIN-WATER.

The following are the results of the experiments undertaken by Messrs. Lawes and Gilbert, of England, for the determination of the amount of ammonia and nitric acid present in rain-water. The average of the determinations made on monthly mixed samples of rain which fell at Rothamsted, England, during more than a year, gave about one part of ammonia per million of rain-water; the average of many determinations by Boussingault at Alsace, in France, was about four fifths of this amount; while the estimations of M. Betnal and Boussingault at Paris gave as much as 3 or 4 parts, or even more, of ammonia per million of rain-water. The amounts of ammonia obtained by Messrs. Lawes and Gilbert in the rain of different entire months, when considered in connection with the registered amounts of fall, the direction of the wind, and the general characters of the weather, were perfectly consistent in kind with the results of Boussingault in his special examinations of rain falling under different circumstances, of the water of dew, fogs, etc.

In regard to the quantities of nitric acid obtained, the authors do not speak with as much confidence concerning the ammonia, as the methods of determining small quantities of nitric acid are by no means satisfactory. As a general result, however, it would seem that while the per centage amount of ammonia was generally less in the rain of thunder-storms and when there was a large fall of rain, the amount of nitric acid, on the other hand, appeared to be increased under the influence of storms. The results further indicated that the amount of nitrogen yielded by rain-water in the form of nitric acid, was considerably greater than that which existed as ammonia; and since there could be no doubt that nitrates applied as manure greatly enhanced the growth of plants by virtue of the nitrogen they contained, the amount of nitrogen brought down from the atmosphere in the form of nitric acid must be considered to have a very important influence on vegetation.—*Chemical Gazette.*

NEW INVESTIGATIONS IN AGRICULTURAL CHEMISTRY.

The following communication has been read before the French Academy, by M. Roy:—

Of all the ammoniacal salts, the carbonate of ammonia is the only one which furnishes assimilable nitrogen on a large scale. The leguminous plants of artificial soils have the remarkable faculty of absorbing gaseous carbonate of

ammonia by means of their leaves. This property renders these plants valuable in agriculture. Grains in general, those of natural meadows and cereals, do not absorb carbonate of ammonia by means of their leaves, they only absorb it in a state of solution by means of their spongioles.

The nitrogen of the air is not absorbed by the aerial organs of plants, but the nitrogen dissolved in water, which penetrates into plants by means of their roots, is assimilated. This explains the contradictory statements of MM. Boussingault and Ville as to the assimilation of nitrogen. A plant placed in a limited atmosphere, which thus accomplishes all the phases of its development, does not transpire water by means of its leaves. It follows that it only absorbs a limited quantity of water by means of its roots, and consequently an inappreciable quantity of nitrogen.

Plaster produces a direct and marked effect only on plants which absorb carbonate of ammonia in a gaseous state—that is, by means of their leaves; such are the leguminous plants of artificial meadows, lucerne, etc. The effect of plaster is to cause the absorption by the leaves of the carbonate of ammonia which the dew and rain bring to the surface of the earth and plants. During the last stage of decomposition of manures, the nitrogen is disengaged from the soil in the state of carbonate of ammonia. The dew brings it back upon the plants, moistening their surfaces and obstructing their respiratory organs. In these conditions the carbonate of ammonia can not be absorbed. It is disengaged among the first products of the vaporization of the dew before the stomates are dried. The presence of plaster in the soil and on the plants has this effect: 1st, of fixing the ammonia in the dew in a state of sulphate, and forming, at the same time, carbonate of lime; 2d, under the influence of a continued vaporization, when the organs of plants are not moistened, the sulphate of ammonia, which is not volatile in the presence of carbonate of lime, causes a slow disengagement of carbonate of ammonia to the organs of absorption, and the re-formation of sulphate of lime. This latter thus acts indefinitely.

Plaster and the leguminous plants on which it acts consequently aid in enriching nitrogenous manures; it is to this enriching that I attribute generally the potato disease. The careful study of this matter has shown that the disease which destroys the potato is due to the absorption of carbonate of ammonia by the roots of the plants. There is an elaboration of the nitrogen in fermentation in the superior organs, an accumulation of this matter in the tuber—whence all the symptoms and manifestations of the disease. I have proved the correctness of this conclusion by causing the absorption of carbonate of ammonia by some roots, which became thus inoculated, if I may use the term, with the malady in different degrees.—*Comptes Rendus.*

INDIRECT MODE OF DETERMINING THE PRESENCE OF PHOSPHORIC ACID IN ROCKS.

At the last meeting of the British Association, Dr. Daubeny gave an account of a new method adopted by him for indirectly determining the presence of phosphoric acid in rocks, and of obtaining proofs of its existence in the Silurian

rocks. The manner in which he made his examination was by taking certain portions of eleven different species of rock, having the soil which covered it entirely removed. The rock was then bruised till it had the appearance of common soil. He had introduced above 22 cwt. into his garden, and raised a crop of autumn grain upon it, and he was thus able to advance a general theory with regard to the presence of phosphoric acid in the rock. Mr. Gilbert said that the rock would be of little use for manufacturing and agricultural purposes unless it contained at least 50 per cent. of phosphate of lime.

ASSIMILATION OF NITROGEN BY PLANTS.

This subject is still under discussion among the French *savans.* M. Boussingault persists in denying, more strongly than ever, that plants can assimilate nitrogen directly from the atmosphere. His experiments have always been made on limited portions of air, while M. Ville, on his side, has constantly operated in the free air, and perseveringly sustains the fixation of nitrogen. The following explanation, offered by M. Roy, appears to harmonize these discordant results. He admits that nitrogen from the air is not absorbed by the leaves, but that, when dissolved in water, it is taken up by the roots. But a plant in an inclosed portion of atmosphere, which is developed wholly in this condition, does not transpire water by the leaves; and hence must absorb by the roots only a very limited quantity of water, and consequently an inappreciable quantity of nitrogen. Such is the case in the experments of Boussingault. On the contrary, a plant endowed with great powers of transpiration, as wheat, placed in the apparatus of M. Ville, absorbs as much more water as the transpiration is more active from the renewal of the air. The quantity of nitrogen which is then taken up by the water into the interior of the plant, and assimilated, is sufficient to be sensible in analysis.—*Paris Correspondence of Silliman's Journal.*

ON THE PRODUCTION OF CARBONIC ACID GAS BY THE SOIL, ORGANIC, AND MANURES.

Since the time of Saussure we have known that humid organic matters, when exposed to the air, remove oxygen, absorb a portion, and that there is a production of water with their hydrogen, and carbonic acid at the expense of their carbon. But hitherto no chemist has tried to appreciate, even approximatively, the quantity of carbonic acid which the soil and substances in the course of decomposition emit spontaneously into the air. M. Corenwinder, in a recent communication to the French Academy, states that he has ascertained that argilaceous earth, enriched with farm-yard manure, exhales, in 24 hours, 15·70 litres per square metre of surface. This earth contained 12 to 13 per cent. of moisture, and the thickness of the layer experimented on was 8 centimetres. The temperature varied from 68° to 86° Fahrenheit during these observations. As might be expected a soil which contains but little manure producces a smaller quantity of carbonic acid. By stirring the surface a larger proportion of carbonic acid is disengaged, because fresh mole-

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cules of organic matter are exposed to the action of the air. This is probably the cause of the efficacy of deep harrowing or plowing. Manures produce a large quantity of carbonic acid, and most when most decomposed. For example: 1st. Fresh cow-dung gives off, in 24 hours, 12 litres of carbonic acid per square metre; if kept for 4 days it gives about 20 litres of gas from the same superficies. 2d. Fresh horse-dung only exhales 5 litres of carbonic acid per square metre in 24 hours. After 4 days the fermentation becomes so considerable that the production of gas rises to 88 litres per square metre in 24 hours. The thickness of the layers experimented on was uniformly 8 centimetres. Dry sugar and moist wood alcohol do not produce carbonic acid; guano exhales a very small quantity; 1 kilogram of unbleached flax disengages spontaneously from 11 to 12 litres in 24 hours, after having been exposed to the air in a damp state for 3 or 4 days. The temperature during these experiments varied from 68° to 86° Fahrenheit. The results of these experiments show that the quantity of carbonic acid furnished to vegetables by the decomposition of the organic matters in the soil, is more considerable than has hitherto been supposed. It is pretty generally admitted that the carbonic acid necessary to vegetation is due almost entirely to the respiration of animals, and ponderation has been established between the two kingdoms which has been, perhaps, too absolute, when we consider the great quantity of carbon annually fixed in the mass of vegetables which cover the cultivated portions of the earth, and the comparatively small relative quantities of carbonic acid furnished by the respiration of animals. My experiments appear to me destined to prove that if we consider the amount of carbonic acid emanating from animal respiration, combustion, and volcanoes, it will still be necessary to attribute to the production of carbonic acid from the surface of the earth the greater share in the alimentation of vegetables. It is rational to admit from the above that vegetables are placed on the surface of the earth in an atmosphere charged with carbonic acid, which is perpetually being renewed, and is the most abundant when the temperature is high and the soil moist—circumstances which aid the decomposition of manures.

ON THE ORIGIN OF GOITRE.

M. Maumené, of France, has recently been engaged in investigating the causes of goitre, or the frightful swelling of the glands of the neck so common in Switzerland and some districts of France. Goitre is undoubtedly due to the action of certain waters in particular cases. Some young men have been known to give themselves goitre in 2 or 3 months to escape military service; successive families have been found to be attacked with goitre when they occupied houses on certain streams; even animals develop it in these conditions. M. Maumené, suspecting that the fluorid of calcium might have an important influence, administered this salt, together with the fluoride of sodium, to a small dog for about 4 months. The effect was to produce an enlargement of the neck to such an extent as to attract notice, which enlargement has remained permanent.

ON THE CONSTITUTION AND PROPERTIES OF OZONE, BY THOMAS ANDREWS, F.R.S.

The conflicting views which have so long existed as to the true constitution of ozone, induced the author to undertake a careful investigation of the whole subject, particularly as he had reason to doubt the accuracy of the only quantitative experiments which have yet been made to elucidate this difficult question. According to the experiments before made, two substances have been confounded under the name of ozone, one a compound body, having the formula HO^3, the other an allotropic variety of oxygen. To ascertain whether, in conformity with this statement, ozone obtained in the electrolysis of water contains hydrogen as a constituent, the author made two series of experiments. In the first series he followed nearly the same line of investigation by which its compound nature is supposed to have been established, but modified so as to avoid a source of error, which, if neglected, vitiates altogether the results. Electrolytic oxygen, unless very great precautions are taken, is always accompanied with a small but appreciable quantity of carbonic acid, which is liable to be partially absorbed by the potassa set free when a neutral solution of iodide of potassium is decomposed by ozone. By adding a little hydrochloric acid to the solution of iodide of potassium before the commencement of each experiment, this error may be avoided. The method of performing the experiment was to conduct a stream of electrolytic oxygen through a compound apparatus previously weighed, which contained on one side an acid solution of iodide of potassium, and on the other sulphuric acid; the former to decompose the ozone, the latter to prevent the escape of moisture. The increase in weight of this apparatus gave the entire weight of the ozone, and the iodine, when set free and reduced to its equivalent in oxygen, the weight of the active oxygen.

The result of five experiments performed in this manner, proved that the active oxygen is exactly equal to the weight of the ozone, and is therefore identical with it.

In the next series of experiments, the author shows that no water is produced by the decomposition of electrolytic ozone by heat. Large quantities of electrolytic oxygen, containing from 38 to 27 milligrams of ozone, were decomposed by heat, but no water was obtained in a weighed absorption apparatus, in which the gas was exposed, not only to the action of sulphuric acid, but was also passed through a tube containing anhydrous phosphoric acid. Having confirmed by new experiments the fact that ozone is formed by the action of the electrical spark on pure and dry oxygen, the author proceeds to institute a comparison between the properties of ozone derived from different sources. These he found to be in every respect the same. The ozone, however prepared, is destroyed, or rather converted into ordinary oxygen, by exposure to a temperature of about 237° Centigrade, and catalytically, by being passed over peroxyd of manganese, no water being formed in either case. It is not absorbed by water, but when sufficiently diluted with other gases, is destroyed by agitation with a large quantity of water; it is also, contrary to the usual statements, destroyed by being agitated with lime-water and baryta water,

provided a sufficient quantity of these solutions be used; it has always the same peculiar odor; it bleaches without producing previously an acid reaction; it oxydizes in all cases the same bodies, etc. From the whole investigation the author draws the conclusion "that ozone from whatever source derived, is one and the same substance, and is not a compound body, but oxygen in an altered, or allotropic condition."—*Proc. Royal Society.*

Influence of Ozone.—For some time past continuous observations have been made in Europe on ozone. The general result of many scattered observers seems to show that there really exists an intimate connection between the quantity of ozone in the air and certain epidemic diseases, such as cholera, grippe, intermittent fever, etc. It is claimed to have been established that the appearance of the grippe coincides with the presence in the air of an excess of ozone; while on the contrary the invasion of cholera is accompanied by an almost complete absence of ozone in the air; this is at least true for Berne, in Switzerland, and Strasburg and Nancy, in France. It will be remembered that this view of the connection of ozone with cholera was taken by some of the medical journals in the United States in 1849, at the time of the cholera invasion.

The following is a new mode of preparing ozone, or a similar body, which is capable of oxydizing silver, decomposing iodide of potassium, of forming ammonia, of disengaging chlorine from hydrochloric acid, and of forming water with hydrogen. It consists in treating peroxyd of barium with monohydrated sulphuric acid at a temperature below 70° Centigrade. The oxygen disengaged in this process possesses the properties named above, and it has the characteristic odor which is known as the *lobster* odor.

ON THE PREPARATION OF CALOMEL IN THE HUMID WAY.

It has long been known that protochlorid of mercury is precipitated from the solution of the perchlorid, by sulphurous acid. This behavior appears to be available in the practical preparation of calomel. It is obtained as a very delicate powder in this manner, and of a dazzling white color, which glistens in the sunlight. The difficult process of sublimation, and the tedious preparation would be thus avoided, and its preparation in the laboratory would be a very easy matter. It would be obtained immediately in the finely-divided state in which the pulverulent sublimed calomel is procured, without any necessity for an operation of so much danger as the preparation of calomel by sublimation, which, moreover, can only be performed on a large scale. As the calomel formed by sulphurous acid is crystalline, and therefore in the same condition as the sublimed, there can also be no doubt that it will not differ from this in its medicinal efficiency. For its preparation it is only necessary to dissolve commercial perchlorid of mercury in water heated to about 122° Fahrenheit, until this is saturated, and afterward to pass sulphurous acid gas into the hot solution. The gas is evolved by heating coarse charcoal powder with concentrated sulphuric acid. The separation of the calomel commences immediately. When the solution is saturated with gas, it is digested for a time, then left to get cool, and filtered from the

calomel, which is afterward washed.—*Professor Wholer, Chem. Gazette*, July 18, 1854.

MISCELLANEOUS CHEMICAL IMPROVEMENTS.

Black Stain for Wood.—The *London Chemical Gazette* gives the following: 4 lbs., or two quarts of boiling water are poured over 1 ounce of pounded commercial extract of logwood, and when the solution is effected, 1 drachm of yellow chromate of potash is added, and the whole well stirred. The fluid is then ready for use as a writing ink or wood stain. It has a beautiful violet blue color, but when rubbed upon the wood it produces a pure black. It is applied to the wood without warming or any other preparation by means of a brush or sponge. When dry, the application of the dye is repeated, and three, or at most four applications, produce a deep black color, which acquires the highest beauty when polished or stained, and with equally good results with different kinds of wood.

Softening Horn.—The London *Artisan.* mentions an invention for softening horn, and rendering it elastic like whalebone. The horns are cleaned, split, opened out and flattened, and immersed for several days in a bath composed of 5 parts of glycerine, and 100 parts of water. They are then placed in a second bath, consisting of 3 quarts of nitric acid, 2 quarts of pyroligneous acid, 12½ lbs. tannin, 5 lbs. bitartrate of potash, and 5 lbs. sulphate of zinc, with 25 gallons of water. After leaving this second bath it will have acquired a suitable degree of flexibility and elasticity to enable it to be used as a substitute for whalebone for certain purposes.

Improvement in Preparing Vegetable Fiber.—The following is the claim of a patent recently granted to J. Blane, of New Orleans, for improvements in preparing vegetable fibers:—I do not claim burying the plants in either wet sand or mud, as described in the "India" process, found in the *Agricultural Reports* of the Patent Office for 1854, page 174. Nor do I claim simply rotting the plants on end with the butts down. But I claim the staking of the plants, butts down, in a pit dug for said purpose, and surrounding them with dry leaves, or straw, with earth thrown around the same, thereby inclosing them entirely on all sides, leaving the top open and uncovered, as fully set forth.

Gun Cotton.—The use of gun-cotton for artillery has to some extent been adopted by the Austrian government during the past year. Four batteries (32 pieces) have been already constructed, and others are in preparation. Twelve-pounders, intended to be used with gun-cotton, require only the same weight of metal, as six-pounders. The following are some of the results of experimentation with this substance:—A twelve pound ball was fired from a gun, charged with powder, at some thick boards prepared for the purpose, and another ball, of the same weight, was fired from one of the new guns, charged with gun cotton; although the new gun was six hundred yards further from the target than the old one, the hole made by the shot of the former was well defined and clean, while the orifice made by the latter was jagged and splintery.

IMPROVEMENT IN SUGAR REFINING.

In some stages of sugar refining, and in Turkey-red dyeing, bullock's blood, in a natural state, is used, and in this condition it is difficult to carry and disagreeable to keep. To obviate these evils, J. Pillars, of London, has taken out a patent for pressing the clotted blood of animals into cakes, then drying them with currents of hot air. It is afterward ground to powder in a machine, and in that state is used by sugar refiners and dyers. This is certainly a valuable improvement over the old method, if it answers as good a purpose, and the attention of all sugar refiners should be directed to it. The serous portion of the blood which has been pressed out, is dried like the clotted parts, and is supplied to calico-printers for using with their colors, and also to the refiners of wine, for their operations, as a substitute for the white of eggs.

RENDERING WOVEN FABRICS WATER-PROOF.

An invention by James Murdock of London, renders cotton cloth waterproof by the application to its surface of the following varnishes:—In three gallons of water, half a pound of alum, one pound of ox-gall, and two pounds of linseed cake, are boiled for one hour, then allowed to cool, and applied with a brush to the surface of the cloth to be coated, which is afterward placed in a stove-room to dry. The next coating is composed of 3 gallons of linseed oil, ¼ lb. of litharge, ½ lb. of India-rubber, ½ lb. of tar, and ½ lb. of Prussian blue—the latter as a coloring material. These are boiled for about an hour, and well stirred all the time, when it will form a strong varnish. It is now allowed to cool, and is put on the surface of the cloth with a brush or machine. The cloth is then allowed to dry again in a stove room, and when dry, its surface is rubbed with pumice-stone to make it smooth. The third and last coat is composed of 3 gallons of linseed oil, boiled over a strong fire for 2 hours, with 2 ozs. of the salts of tin, and the same amount of the sulphate of zinc—both dryers. This varnish may also be colored with Prussian blue, or other coloring material. When cold, it is applied to the surface of the cloth like the other coatings, and the cloth is afterward dried in the same manner. The last coating is given with a thin copal varnish.

ON THE ABOLITION OF THE SMOKE NUISANCE IN ENGLAND.

At a recent scientific meeting in England, Mr. Spence questioned the great benefit likely to be derived from the abolition of the smoke nuisance. The imperfect combustion of fuel, as carried on at present, only led to an annoying deposit of carbon, and this Mr. Spence regarded as a healthy body. By the more complete burning of the fuel, this carbon would be oxydized into carbonic acid, a poisonous gas, and the sulphur at present escaping combustion would pass into sulphurous acid. He instanced the smoke-consuming movement in Manchester, and observed that vegetation in the neighborhood was being destroyed, owing to the very much larger quantity of carbonic and sulphurous acids, which were now thrown into the atmosphere.

CHARCOAL RESPIRATOR.

Dr. Stenhouse recently described to the London Society of Arts a new species of respirator filled with powdered animal charcoal, to absorb and de stroy any miasmata or infectious particles present in the air in the case of fever and cholera hospitals, and of districts infected by ague, yellow fever, and similar diseases. The respirator fitted closely to the lower portion of the face, extending from the chin to within half an inch of the eyes, and projected about an inch on either side of the mouth. It therefore included the nostrils as well as the mouth. The frame of the respirator was made of thin sheet copper, but the edges were formed of lead, and were padded and lined with velvet, so that it could be easily made to fit tightly to the face. The powdered charcoal was kept in its place by means of two sheets of fine wire gauze, about a quarter of an inch apart. The object in view was, by filtering the air through such a porous substance as animal charcoal, to intercept the miasmata which might have got mixed with it. Repeated trials with the respirator had shown that certain noxious and offensive gases, such as ammonia, sulphureted hydrogen, and hydrosulphate of ammonia, had been rapidly oxydated and destroyed in their passage through the pores of the charcoal. The author then mentioned several instances in which the bodies of dead animals had been completely covered with thin layers of charcoal, which entirely prevented any effluvia or odor being perceptible. He considered that covering a church-yard to the depth of from two to three inches with coarsely-powdered charcoal, would effectually prevent any putrid exhalations ever finding their way into the atmosphere. Charcoal, though a deodorizer or disinfecting agent, was not, as laid down by chemical works, an antiseptic. On the contrary, it favored the rapid decomposition of the dead bodies with which it was in contact; so that in the course of six or eight months little was left except the bones.

An interesting experiment illustrating the sanitary powers of charcoal has been instituted at St. Bartholomew's Hospital, London, by Dr. Stenhouse. An atmosphere rendered highly offensive by putrefactive decomposition going on within the chamber in which it is confined, is drawn through charcoal filters, by means of a rotating fan machine, and is passed into an apartment adjoining. Although this air is disgustingly fetid, it flows out into the room perfectly free from smell. The remarkable property which charcoal has of condensing within its pores large quantities of the fetid gases is greatly increased by a process of platinizing the charcoal. This new invention merits the attention of the man of science, from the extraordinary energy with which ie acts upon the gases, and of all those persons—scientific or not—who are interested in the public health, since it furnishes us with a new power for removing from among us the agents of disease.

GEOLOGY.

ON THE GEOLOGY OF EXTREME NORTHERN AMERICA.

At a recent meeting of the London Geological Society, Mr. Isbister presented a paper on the geological features of the extreme northern portions of America. In respect to the Rocky Mountains, he stated that granite, limestone, and slate (probably of Silurian age), and conglomerate and sandstone, have been met with on their eastern slopes. Rocks probably referable to the Carboniferous series, have been found by the author near the northern extremity of the range. The Lawrentine Mountains, or the range flanking the north bank of the St. Lawrence, also consist of granite, with other crystalline rocks. These are prolonged (with a narrow slip of palæozoic rocks intervening) in a N.W. direction, from Lake Superior to the Arctic Sea, in a broad zone of but slight general elevation. It is crossed by numerous rivers, and greatly intersected by lakes; indeed, along its western margin nearly all the great lakes of North America occur. Between this range and Hudson's Bay is the great Silurian basin of Hudson's Bay, which extends also along the northern margin of the Lawrentine Mountains. The shores of the Bay itself are flat and alluvial. The Silurian limestone of Hudson's Bay has been traced more or less continuously to the Arctic Sea, through the enormous range of thirty degrees of latitude; and the fossils obtained from it, both in the North and near Hudson's Bay, appear to belong exclusively to the Upper Silurian series. The Silurian basin of Lake Winnipeg was next described. Many fossils have been collected, but some obscurity still exists with regard to the age of the rocks of this tract; in some respects they appear to be referable to the Lower Silurian age. The valley of the Mackenzie River is chiefly occupied by rocks of Devonian age, in which sandstones alternate with bituminous shales, sometimes to a depth of 150 feet. In the Mackenzie Valley there are also rocks referable to the Silurian, and some which the author refers with doubt to the Carboniferous series. The latter include—1st, the great alum-shale deposits occurring along the Arctic coast from Mackenzie River to Liverpool Bay; 2d, the extensive band of lignite and coal, described by Sir J. Richardson, from whose account it appears that a vast coal-field skirts the eastern base of the Rocky Mountains, and is apparently continued far into the Arctic Sea, where coal has lately been met with by Captain M'Clure. In the drift-coal of Jameson's Land and of Melville Island, and in the coal-fields of Oregon, plants like those of the English coal measures have been found. The author

next noticed the few patches of fossiliferous pleistocene deposits yet observed on the Arctic shores, and the drift phenomena of the whole region under consideration.

ATTEMPTS TO SOUND THE NIAGARA RIVER.

Several attempts have recently been made to sound the river below Niagara Falls, one of which is thus described: "The attempt was made with an iron of about 40 lb. weight, attached to a No. 11 wire, all freely suspended, so as not to impede the fall of the weight. I then let the weight fall from the bridge, a height of 225 feet. It struck the surface fairly, with the point down—must have sunk to some depth, but was not longer out of sight than about one second, when it made its appearance again on the surface, about 100 feet down the stream, and skipped along like a chip, until it was checked by the wire. We then commenced hauling in slowly, which made the iron bounce like a ball, when a cake of ice struck it, and ended the sport. I am satisfied that no metal has sufficient specific gravity to pierce that current, even with a momentum acquired by a fall of 225 feet. The velocity of the iron when striking must have been equal to 124 feet per second; and, consequently, its momentum near 5,000 lbs. Its surface opposed to the current was about 50 superficial inches. This will give an idea of the strength of that current, and at the same time hint at the Titan forces that have been at work to scoop out the bed of the Niagara river."

OBSERVATIONS ON THE COAL-FIELDS OF PENNSYLVANIA.

The following interesting remarks on the coal-fields of Pennsylvania are made by Professor H. D. Rogers, as introductory to a description of numerous species of new fossil plants found there:—

The following new species of fossil plants, one hundred and ten in number, are some of the results of a systematic investigation of the fossil flora of the carboniferous strata of Pennsylvania and the adjacent coal-fields of Ohio and Virginia. Many of these hitherto undescribed forms were discovered in the slates, associated with the beds of anthracite in the coal-fields of eastern Pennsylvania, which, compared with the bituminous coal measures of western Pennsylvania, appear not only to contain a greater variety of species, but to present them in a condition of more perfect preservation for study.

These species, as briefly described by Mr. Lesquereux, associated with Professor Rogers in the Geological Survey of Pennsylvania, constitute about one half of the total number of well-defined forms hitherto detected by him in the coal measures and lower carboniferous rocks (the vespertine series) of Pennsylvania; more than one hundred of the two hundred and twenty species examined by him proving to be entirely identical with species already recognized in the European coal-fields, and some fifty more of them showing differences so slight, that a fuller comparison with better specimens, may result in their identification likewise. As a further evidence of the near affinity of the North American to the European fossil flora of the carboniferous age, he has re-

marked, in the course of his investigations, that even these new species which seem restricted to this continent, are every one of them in close relationship with European forms. It deserves mention, moreover, that the commonest European species are likewise the most common American ones.

A stratigraphical analysis of the anthracite measures of Pennsylvania calls for their division into two groups, a lower series, distinguished by the *white* or very pale color of the ashes of nearly all the coal seams, and an upper series, including coals as remarkable for yielding only pinkish or red ashes. Between these groups there usually exists, especially in the southern or Pottsville basin, a small transition group of two or three beds of gray ash, or pinkish-gray ash coals. The entire number of coal seams, of a thickness admitting mining, in the middle portion of the southern basin, where the whole formation is thickest and most replete in coal-beds, does not exceed about twenty-five; and counting those of all dimensions, the total series does not amount to more than from thirty to thirty-five separate layers.

In the bituminous coal-measures west of the Alleghany Mountains, the whole number of workable seams is less than one half of that above named, as belonging to the anthracite formation, while, including the thinner and less persistent beds, the entire series can not there amount to more than eighteen or twenty. That portion of this great Appalachian coal-field which lies within Ohio, appears to possess even somewhat fewer than the eastern half in Pennsylvania, the beds suitable for mining being estimated at seven, and the small seams about ten, in addition. Advancing westward to the great coal basin of Indiana and Illinois, the coals thick enough for working are counted at only six, and the thin ones proportionately few; and this remarkable progressive reduction in the coal-beds, going westward, seems to be maintained as far as we advance in the formation; for crossing the Mississippi to the wide shallow coal-fields of Missouri and Iowa, the number of workable beds there believed to exist does not amount to more than three or four. Accompanying this interesting gradation in the amount of coal, there occurs an equally noteworthy diminution in the thickness and coarseness of the associated strata, showing a progressive thinning down of the whole land-derived coal-bearing portions of the carboniferous deposits. Wherever I have studied either of the anthracite fields of the great Appalachian basin, I have remarked that the lower, or "white ash" division of the coal measures gives indications of more violent and frequent disturbances of level in the surface at the time of the deposition of the strata, than are noticeable in the composition of the upper or "red ash" part of the formation. Among the proofs are, more abrupt and frequent alternations of coarse and fine deposits, more diversified and rapid changes in the thickness, composition, and arrangement of the strata, both of the mechanical deposits and the life-derived beds of coal, and the far greater mutability and inconstancy of all those strata, even the most quietly deposited, within the same area or extent of outcrop. The lower strata of the anthracite coal measures are, indeed, remarkable for the diversity in the coarseness of the sandstones, and for the unsteadiness in thickness of the coal-beds themselves. Though these carbonaceous layers are the accumulations of once perfectly level sea-meadows, at successive depressions of the surface,

it is evident, from their comparatively rapid thickening and thinning, and frequent coalescing and diverging, that the floors upon which they were collected were neither so wide as those which grew the vegetation that resulted in the bituminous coal-beds, nor so uniform and gradual and horizontal in their slow movements of elevation and depression. Commensurate with the more fluctuating size and more restricted range of these lower coal seams, is a greater inconstancy and diversity in their fossil flora. The more widely extended upper beds appear to exhibit a more limited specific vegetation, expanded over wider areas.

As far as our researches have gone, we notice that the lower strata, both in the anthracite measures and in the great Appalachian coal field, abound in the larger species, especially in Lepidodendra, while the higher seams are characterized by the smaller *herbaceous species*, most generally the herbaceous ferns. We conceive that the large proportion of species common to the coal strata of North America and Europe clearly establishes identity of age between the two deposits, and a close accordance, if not identity, in the geographical and climatal conditions prevailing at their formation. A yet closer agreement is noticeable between the species found in the several coal fields in the United States. Indeed so alike are all the anthracite basins in their fossils that Mr. Lesquereux already recognizes more than 20 familiar European species as common to these once continuously united coal fields. It has been indicated above that the two different groups of the coal strata of Pennsylvania—the lower or white ash, and the upper or red ash—are characterized by somewhat different species, though these more or less intermingle. Satisfied of this fact of a general prevalence of certain forms in certain parts of the coal measures, we have aimed at carrying our inquiry a step further to ascertain whether or not any or all of the individual coal seams themselves are separately recognizable by their fossil plants. Undoubtedly, in some of the broadly-deposited and uniformly-conditioned coal beds and coal slates of the western bituminous coal fields, we do observe a most striking prevalence of the same species within the same layer, over comparatively wide areas; but amid the more irregularly accumulated beds, of especially the lower or white ash anthracite strata, formed on a less stable portion of the nowhere absolutely stationary crust, the inconstancy in the vegetation of even the same coal seam is for the most part, if not even quite, too great to permit us to attempt to identify it by its fossils merely. Again, in some instances, coal beds which are demonstrably different, are almost absolutely identical in their fossils. This is the case with the "Gate" and the "Salem" coals, near Pottsville. So strikingly alike are they in their vegetation, that Mr. Lesquereux strongly inclines to regard them as but the detached parts of originally one sheet of coal, and to suspect that there is some error of obscurity in my section, which shows them to be separated by several hundred feet of strata, including a number of beds of coal. Of the validity of the proofs showing the so-called vein to be different coal from the Gate vein, and several stages higher in the series, there can not, however, be any question, and the palæontological evidence for identity must give way before the higher and decisive demonstration from superposition of their difference in age.

PHYSICAL CHANGES IN THE CHARACTER OF THE NORTH AMERICAN CONTINENT.

The following letter was directed to the Secretary of the New York Historical Society, by Professor Agassiz, in answer to an inquiry whether his forthcoming work—"Contributions to the Natural History of the United States"—would bear upon the civil history of our country. In reply Professor Agassiz says: I hardly need remind you of the fact that the attention of historians has but recently been called to the importance of considering the physical character of the different parts of the world in connection with the successive centuries of civilization and the primitive abode of the different races of men. But there is one feature of this subject which has thus far been entirely neglected. I allude to the character of the vegetation and the animal creation in each natural area of the globe, which must at all times have greatly influenced every where the progress of civilization, a picture of which may in future be expected as a sort of frontispiece to the general history of every great country. There are still other more general features yet little known even to naturalists, which may in time add another charm to these contemplations of the Kosmos—the contrast between the different parts of the world when compared with the previous conditions of our globe in successive geological periods. For instance, Europe has a physical character now which is not exemplified in any of the past ages of our earth, while New Holland, as it is now, reminds us of the condition of certain portions of Europe during the middle geological ages (the Jurassic period in particular), and North America recalls, both by its physical condition, its large lakes among others, and its animals and plants, features prominent in Europe during the tertiary times; and I need only allude to the opossum, the snapping-turtle, the bull-frog, the large salamanders, etc., the hickories, the swamp-cedar, the white gum-tree, etc.—all found in the tertiaries of Europe, and now entirely extinct there—to show the resemblance. Moreover, North America nourishes now a number of fishes, and other animals, such as the king-crab, no representatives of which are found alive in any other part of the globe, though they were largely distributed over Europe in several geological periods. This character of the North American fish fauna is so peculiar that, in alluding to it, I have often been tempted to apply to it the epithet of old-fashioned. Two of these curious fishes occur even in the State of New York—the gar-pike and the so-called mud-fish—and the others are scattered over other parts of the country. I shall, of course introduce a full account of these remarkable relics of past ages in my new proposed work, for they throw as much light upon the physical condition of former periods in the history of our globe, as the ruins of Egypt and Nineveh would furnish upon the history of those periods in the life of mankind, could they be restored to their former splendor before our gaze, and studied in the full animation of their greatest prosperity, as we may investigate our living animals. May I not add to all this that there are features in the embryonic growth of animals which signify, as it were, the natural growth of mankind? So true is it that while civilization has gradually estranged

man from nature, a higher degree of intellectual culture brings us back and nearer to its wonders.

GEOLOGY OF CENTRAL AFRICA.

The following interesting facts respecting the geology and topography of Central Africa have been gleaned from the reports of Dr. Vogel, who, it will be remembered, has succeeded Dr. Barth in the work of exploration.

The great plain of Central Africa presents nowhere as far as $9\frac{1}{2}°$ north latitude (a few isolated small granitic cones excepted) an elevation exceeding 950 feet. Dr. Vogel says that in about 11° north latitude, 120 miles from Kuka, he found, at a depth of 20 feet under the surface of the ground, the same layer, consisting of limestone and freshwater shells, which he met with at Kuka 6 feet under the ground, and he suggests that the whole region extending thus for upward of 100 miles S.S.E. from Kuka, was at one time occupied by Lake Tsad, when its limits extended greatly beyond its present ones. But whether this assumption be correct or not, the well-ascertained fact as to the slight elevation of that region, together with the results of the previous hypsometrical observations of Dr. Vogel and Dr. Overweg, as well as of the discoveries and acute estimates of Dr. Barth, relating to altitudes, are well worthy consideration, as they completely upset our previous notions of African geography. It is well known that all our best authorities represent the Great Desert of Sahara, and nearly the whole of Northern Africa, as one vast plain, if not a dead level, at least one of very little elevation; whereas, immediately to the south of Lake Tsad, the existence of mountain ranges, alpine groups, highlands, and mighty table-lands of many thousand feet elevation was asserted and taught us as well-established facts. Now, from the observations made by the members of the Expedition to Central Africa, this is found to be quite the reverse, and both features may be truly said to have changed places—an extensive table-land, from 1,000 to 2,000 feet average elevation, occupying the Sahara; whereas, on the other hand, the extensive basin of Lake Tsad and the River Shary forms a great interior depression, which attains its minimum elevation in the lake with 850 feet. On every side the basin of Lake Tsad is fringed with more or less elevated tracts which separate it from the other hydrographical systems, as, for instance, those of the Nile and the Kowara. These new facts of the relative elevation of Inner Africa also explain to us many features connected with the physical configuration, the climate, botany, and zoology of the regions they refer to.

The countries round Lake Tsad form an immense alluvial plain. Dr. Vogel, after leaving the oasis of Aghadem, situated upward of 250 geographical miles north from Kuka, did not see a single rock or stone till he came to Waza, which lies upward of 100 miles S.S.E. of Kuka, thus leaving an alluvial tract between the two points of upward of 350 geographical miles in the heart of Africa. At Waza an isolated group of granitic cones rises almost perpendicularly out of the alluvial plain to the height of 400 feet above their basis.

ON THE GROOVING AND POLISHING OF HARD ROCKS AND MINERALS BY DRY SAND. BY W. P. BLAKE, U. S. GEOLOGIST.

The phenomena about to be described were observed in the pass of San Bernardino (California), in 1853. This pass is one of the principal breaks through the southern prolongation of the Sierra Nevada, and connects the Pacific slope with the broad and low interior plain of the Colorado Desert. It is bounded on each side by high mountains; the peak of San Bernardino rising on the north to the height of about 8,000 feet, and San Gorgonio on the south to about 7,000 feet. The elevation of the summit level is 2,800 feet above the Pacific, and the width of the gap at that point is about two miles. On the eastern declivity of the pass—the side turned toward the desert—the granite and associated rocks which form the sharp peak of San Gorgonio, extend down to the valley of the pass in a succession of sharp ridges, which being devoid of soil and vegetation, stand out in bold and rugged outlines against the clear unclouded sky of the desert region. It was on these projecting spurs of San Gorgonio that the phenomena of grooving were seen. The whole surface of the granite over broad spaces, was cut into long and perfectly parallel grooves and little furrows, and every portion of it was beautifully smoothed, and though very uneven, had a fine polish. For a moment it was impossible to realize the cause of all this abrasion performed in a manner so peculiar. The action of glaciers and of drift was thought of in succession, but the appearance of the surface was so entirely different from that of rocks which have been acted on by these agents, that I could not regard them as the cause. While contemplating these curious effects, the solution of the problem was presented. The wind was blowing very hard, and carried with it numerous little grains of sand. When I stooped down and glanced over the surface of the rocks, I saw they were enveloped in an atmosphere of moving sand, which was passing over and accumulating in deep banks and drifts on the lee side of this point. Grains of sand were thus pouring over the rocks in countless myriads, under the influence of the powerful current of air which seems to sweep constantly through the pass from the ocean to the interior. Wherever I turned my eyes—on the horizontal tables of rock, or on the vertical faces turned to the wind—the effects of the sand were visible; there was not a point untouched, the grains had engraved their track on every stone. Even quartz was cut away and polished; garnets and tourmalines were also cut and left with polished surfaces. Masses of limestone looked as if they had been partially dissolved, and resembled specimens of rock salt that had been allowed to deliquesce in moist air. These minerals were unequally abraded, and in the order of their hardness; the wear upon the feldspar of the granite being the most rapid, and the garnets being affected the least. Whenever a garnet or lump of quartz was imbedded in compact feldspar and favorably presented to the action of the sand, the feldspar was cut away *around* the hard mineral, which was thus left standing in relief above the general surface. A portion, however, of the feldspar upon the lee side of the garnets, being protected from the action of the sand by the superior

hardness of the gem, also stood out in relief forming an elevated string, osar-like, under their lee. When the surface acted on was vertical and charged with garnets, a very peculiar result was produced; the garnets were left standing in relief, mounted on the end of a long pedicle of feldspar, which had been protected from action while the surrounding parts were cut away. These little needles of feldspar tipped with garnets, stood out from the body of the rock in horizontal lines—pointing, like jeweled fingers, in the direction of the prevailing wind. They form in reality a perfect index of the wind's direction, recording it with as much accuracy as the oak-trees do in the region about San Francisco, where they are all bent from the perpendicular in one direction, or in some places lie trailing along the ground. All these little fingers of stone pointed westward, in the direction of the valley of the pass, to which the wind conforms. We experienced the wind before reaching the point of rocks and the sand drifts: it blew with great violence and seemed to be a great air-current, as uniform in its direction and action as the great currents of the sea. It flows into the interior with singular persistence and velocity, sweeping down over the slope of the pass, not in fitful gusts and eddying whirls, but with a constant uniformity of motion unlike any of the winds of our Atlantic seabord, or of the plains. The pass would, in fact, seem to be a great draught-channel or chimney, to the interior, through which the air makes inland from the cool sea, to supply the vacuum caused by the ascent of a column of heated air from the parched surface of the heated desert. This pass is the only break of any magnitude in the mountain chain for a long distance, and as an air-channel, holds the same relation to the Colorado desert as is sustained by the Golden Gate at San Francisco to the broad interior valleys of the Sacramento and San Joaquin.

The effects of driving sand are not confined to the pass; they may be seen on all parts of the desert where there are any hard rocks or minerals to be acted on. On the upper plain, north of the sand hills, where steady and high winds prevail, and the surface is paved with pebbles of various colors, the latter are all polished to such a degeee that they glisten in the sun's rays, and seem to be formed by art. The polish is not like that produced by the lapidary, but looks more like lacquered ware, or as if the pebbles had been oiled and varnished. On the lower parts of the desert, or wherever there is a specimen of silicified wood, the sand has registered its action. It seems to have been ceaseless at work, and when no obstacle was encountered on which wear and abrasion could be effected, the grains have acted on each other, and by constantly coming in contact have worn away all their little asperities, and become almost perfect spheres. This form is evident when the sand is examined by a microscope. We may regard these results as most interesting examples of the denuding power of loose materials transported by currents in a fluid. If we can have distinct abrasion and linear grooving of the hardest rocks and minerals by the mere action of little grains of sand falling in constant succession and bounding along their surface, what may we not expect from the action of pebbles and boulders of great size and weight, transported by a constant current in the more dense fluid, water? We may conclude that long rectilinear furrows of indefinite depth may be

made by loose materials, and that it is not essential to their formation that the rocks and gravel, acting as chisels or gravers, should be pressed down with violence or imbedded in ice, or moved forward *en masse* under pressure by the action of glaciers or stranded icebergs.

If it were possible it would be exceedingly interesting to ascertain the length of time required for the little grains of sand to carve the surface of the granite ridge to its present form. How inappreciably small must be the effect produced by a single grain! And yet by their combined and long-continued action mighty effects are produced. That the action of the grains singly is not visible, is proved to us by the polished surface, for no one grain cuts deeply enough to leave a scratch. Ages have doubtless elapsed since this action of the sand began, and we can not tell how deep the abrasion has extended: cubic yards of granite may have been cut into dust and driven before the wind over the expanse of the desert.—*Silliman's Journal.*

ANCIENT LAKE IN THE COLORADO DESERT.

Mr. W. P. Blake, the geologist of the U. S. Pacific Railroad Survey in California, under the command of Lieutenant R. S. Williamson, U. S. Topographical Engineer, recently reports that a large tract of country, over one hundred miles in length, at the head of the Gulf of California, has been overflowed at a comparatively recent period, and probably by the waters of the Gulf.* There is evidence of the existence of a vast lake there, which occupied nearly the whole area of the present desert. This lake was of fresh or brackish water, as is shown by the numerous shells which are found in the thick strata of blue clay forming the surface of the desert. At the base of the mountains along the borders of the desert, distinct beach-lines, or water-lines, were found on all the rocks, and the surface of the last was found to be covered with a thick calcareous crust, nearly two feet thick in some places. This calcareous coating was seen to extend up the sides of the mountain spurs for a height, in some places, of over one hundred feet, and its upper limit has a well-defined horizontal line, marking the former level of the water.

Mr. Blake considers it probable that the Gulf of California once extended as far north as the base of the pan of San Bernardino, 175 miles north-west of its present limits, and that the deposition of silt from the Colorado river has gradually accumulated opposite its mouth, so as to isolate the upper part of the Gulf, and leave it in the condition of a lake, fed at times by the overflow of the Colorado, until at length the evaporation became more rapid than the supply, and the desication of the lake was effected—a result which would be soon accomplished in that region of high and arid winds. This explanation is supported by the present phenomena, for the Colorado continues to overflow, and send streams off toward the north at times of great freshets. There is much reason for believing that a part of the desert-valley north of the present lagoons, which are fed by the off-shoots from the Colorado, is below the level of the sea. This subject is discussed at length in the report,

* Preliminary Geographical Report, accompanying the Report of Lieutenant R. S. Williamson, House Documents, 129, Washington, 1855.

and many important facts concerning that singular and interesting region are given.

CHRONOLOGY OF THE FORMATIONS OF THE MOON.

Professor Nichol at the British Association stated that to our satellite hitherto those very ideas have been applied which confused the whole early epochs of our terrestrial geology, the notion, viz., that its surface is a *chaos*, the result of primary, sudden, short-lived and lawless convulsion. We do not now connect the conception of irregularity with the history of the earth:—it is the triumph of science to have analyzed that apparent chaos, and discerned order through it all. The mode by which this has been accomplished, it is well known, has been the arrangement of our terrene mountains according to their relation to time: their relative ages determined, the course of our world seemed smooth and harmonious, like the advance of any other great organization. Ought we not then attempt to apply a similar mode of classification to the formations in the moon—hoping to discern there also a course of development, and no confusion of manifestation of irregular convulsion? Professor Nichol then attempted to point out that there appeared a practical and positive mode by which such classification might be effected. It could not, in so far as he yet had discerned, be accomplished by tracing, as we had done on earth, relations between lunar upheavals and stratified rocks; but another principle was quite as decisive in the formation it gave, viz., the intersection of dislocations. There are clear marks of dislocation in the moon—nay, the surface of our satellite is overspread with them. These are the rays of light, or rather bright rays, that flow from almost all the great craters as their centers, and are also found where craters do not at present appear. Whatever the substance of this highly reflecting matter, it is evidently no superficial layer or stream, like lava, but extends downward a considerable depth into the body of the moon. In short, we have no likeness to it on earth, in the sense now spoken of, except our great trap and crystalline *dykes*. It seemed clear, then, that the intersection of these rays are really *intersections of dislocations*, from which we might deduce their chronology. Can the intersection, however, be sufficiently seen?—in other words, is the telescope adequate to determine which of the two intersecting lines has disturbed or cut through the other? Professor Nichol maintained the affirmative in many cases, and by aid of diagrams, taken down from direct observation, illustrated and enforced his views.

ON THE "MAUVAISE TERRES" OF NEBRASKA.

The following is an abstract of a paper on the above subject read at the last meeting of the American Association by Professor James Hall:—The country on the Upper Missouri River—Nebraska—he said had been known to us for many years; but, until within a few years past, our knowledge had been derived from Lewis and Clark, Nicolay, and some others. All these had brought specimens from Nebraska, from which we have learned that for a great distance along the Missouri River, beginning at the mouth of the Platte

and extending several hundred miles northerly, there was a cretaceous formation, the most prominent fossils of which were Ammonites and Baculites. All had shown that this existed on a largely developed scale, but, with the exception of Nicolay, no attempt was made to establish subdivisions. In 1847 we had for the first time a published notice of the existence of an extensive tertiary formation in that region, given by Dr. Prout, of St. Louis. This was, however, to the west of Missouri. Subsequently Mr. Culbertson brought collections, and Dr. Owen directed Mr. Evans to make collections, from which we had a pretty good knowledge of the tertiary formation and its fossils. Mr. Hall's object in making collections was not to make discoveries of new species, but the investigations of Dr. Owen did not tell us whether there were distinct formations or not, and moreover it seemed an important consideration that the flora corresponding to the ancient fauna should be known. That was not accomplished by the expedition sent out under the charge of Mr. Meeks; but we had some more details with regard to the tertiary and cretaceous formations. In the neighborhood of the mouth of the Platte the carboniferous formation terminated. Passing up the Missouri we found that the carboniferous passed into cretaceous. At their junction was a sand-stone, which might perhaps be older than the cretaceous. Upon it lay a buff calcareous rock, which would mark like chalk, containing scales and jaws of fishes. Above this was a great thickness of clays which contained most of the species that had been brought from this part of the country. A thinner bed above the clay was characterized by a large baculites. Those subdivisions extended over the western country, and we had yet to seek their characteristic fossils. The species already described already amounted to between thirty and forty, and he had about an equal number of new species. At a considerable distance west of the Missouri, the cretaceous beds began to dip slightly to the west. Above the bed characterized by baculites, and 80 miles west of the Missouri, commenced the tertiary, at first containing no fossils, but about 80 miles further on there were palæotherium and fossil turtles within twenty feet of the cretaceous, although the tertiary nearer the river was 50 or 60 feet high. They concluded, therefore, that the beds were unconformable, the cretaceous dipping westward, and the tertiary being deposited horizontally upon it so that the eastern tertiary began to be deposited when the western was already 250 feet thick. The Mauvaises Terres were formed of this tertiary extensively denuded. Two new species of mammals had been discovered, one of them allied to the musk deer, and the other a small, carnivorous animal. The shortest term to express the character of Nebraska was to say that it was a perfect desert, incapable of supporting men or animals, except in a migratory condition. The buffaloes came in the spring with the grass, and went away in midsummer when it was gone, and the Indians followed them. There was almost no wood; some few shrubby willows, and a cotton-wood a foot in diameter was always known as the big cotton-wood, and now that it was gone, the place was still called Big Cotton-wood Spring. Pure water was rarely met with. There were occasionally some springs in the baculite formation which commenced 75 miles west of the Missouri. The deep clay beneath it was almost impassable. In the

spring it was all mud, and in the summer the clay cracked so as to draw out the roots of vegetation and destroy it. Along the bottoms was occasionally a little good soil, but it was not valuable. This clayey soil was dark, but not with organic matter. He had seen in Mr. Meeks's notes that night after night he was compelled to camp with bitter water, and send out the men to gather a few stunted willows or cotton-wood for fire. Most of the water was impregnated with saline materials; and, as all the water in the Mauvaise Terres contained sulphate of magnesia, the party were compelled to submit to its medicinal effects. Southward, toward the Platte was some better land, but little wood. Kansas was much like Nebraska, and the climate was such, that in a great part of the territory it would be difficult for New-England men to exist. He knew that Nebraska was a desert, and would remain so for all time to come. [This curse of barrenness does not apply to the settled portions of Kansas. They are carboniferous.]

Professor Agassiz said that this was very important to us as presenting for the first time the subdivisions of the cretaceous. His friend had omitted in his account of early explorers, the Prince of Neuwied, who in his travels collected cretaceous fossils, and went back to Europe and gave us for the first time the information that there were cretaceous fossils there. Several of them were published, and one species, the mosasaurus, had not been rediscovered. Now it was evident that these cretaceous deposits were not one and the same, but formed a succession of deposits which contained different fossils. Now in Europe the whole series of cretaceous formations had lately been subdivided into a number of subdivisions, and although he agreed completely with the doctrine laid down by the chairman (Professor Dana), that we should not compare our formations servilely to those of Europe, yet the deposition of the whole cretaceous series in Europe and in America were in the main synchronic. He believed that the specimens of Professor Hall, limited as they were, afforded in themselves sufficient evidence that the cretaceous deposits in Nebraska corresponded to the upper strata of the cretaceous in Europe. He had not yet seen a single entire fish-scale, only drawings of fragments of scales, but he was sure that the upper beds were the equivalents of the English white chalk.

Mr. Hall then spoke on the geology of the Rocky Mountains. He said that his knowledge of the Rocky Mountains was derived from specimens brought by Frémont and Emory. All the specimens from the metamorphic regions, whether from the north or south, had one character, and there was a large proportion of red feldspathic granite associated with other rocks. Their age he could not determine. After leaving the mouth of the Platte nothing but the cretaceous and tertiary were to be found until one reached the head waters of the rivers flowing eastward, the cretaceous came out again from beneath the tertiary. He had not yet learned of cretaceous fossils being found west of the Rocky Mountains. Beyond this was the carboniferous limestone belonging above the coal-bearing beds. It generally rested on metamorphic rocks, which formed the bases of the mountains. There were none of the mica and talcose slates so frequent in the Appalachian. The elevation of the Rocky Mountains was post-cretaceous, the cretaceous beds being uplifted with

these metamorphic masses. You continued to find outlayers of the upper carboniferous limestone through the region to the West. Crossing the Rocky Mountains and going toward Salt Lake, tertiary is again found. The ranges west of Salt Lake were all capped with this carboniferous limestone, All the coal deposits of the south-west were of tertiary origin, and he strongly suspected that that brought by Captain Stansbury was tertiary also. There was positively tertiary coal in the plateau between the first range and the Salt Lake.

DRIFT PHENOMENA.

At the Providence meeting of the American Association, President Hitchcock gave an account of the manner in which he was first led to the observance of glacial marks, and the localities in which he had since found them, from Monroe to Shelburne and from Becket to Westfield, on the tributaries of the Connecticut. He was first led to notice them by seeing east and west scratches in the side of a gorge, while on the summits on either side were the north and south striæ of the drift. He had found also what he was compelled to call moraines. He had scarcely explored the Hoosac range at all with this object in view, but it did seem to him that he had too many cases to be the result of imagination.

Mr. Daniels said that in Wisconsin he had found one case of drift-striæ which declined 40 degrees from the meridian, though the variation was generally from 20 to 25.

Mr. Redfield said that the drift-striæ seemed to him to be divided into two systems, one measuring S.S.E. and the other S.S.W. These two systems sometimes occurred together, and seemed to be owing to the two currents, as there were now two currents in the ocean. So far from being led down into the valleys, there was a case in New Jersey where striæ rose up over a high hill, where there was a valley on both sides.

Mr. Leslie cited a more striking similar instance in Pennsylvania, where the valley on one side was 2,000 feet deep. He had seen in Wales Y-shaped valleys, with the point turned upward, which could never be owing to glaciers.

Mr. Lee had noticed similar grooves north of the Catskill Mountain-House, 2,700 feet above the sea.

Dr. Stevens alluded to a block of granite found in the very act of digging a groove in limestone in Western New York. The boulder was considerably rounded.

President Hitchcock said that the difference between drift and modified drift was as distinct as between the silurian and cretaceous formations.

GEOLOGICAL MEMORANDA.

Relative Levels of the Red Sea and Mediterranean.—The French engineers, at the beginning of the present century, had come to the conclusion that the Red Sea was about thirty feet above the Mediterranean, but the observations

of Mr. Robert Stephenson, the English engineer at Suez; of M. Negretti, the Austrian, at Tineh, near the ancient Pelusian, and the levelings of Messrs. Talabat, Bourdaloue, and their assistants, between the two seas, have proved that the low-water mark of ordinary tides at Suez and Tineh is very nearly on the same levels, the difference being that at Suez it is rather more than one inch lower.—*Leonard Horner*, *Proc. Roy. Soc.*, 1855.

Conversion of the Arabian Desert into a Lake.—Captain William Allan, of the British navy, has published a book advocating the conversion of the Arabian Desert into an ocean. The author believes that the great valley extending from the southern depression of the Lebanon range to the head of the Gulf of Akaba, the eastern branch of the head of the Red Sea, has been once an ocean. It is in many places 1,300 feet below the level of the Mediterranean, and in it are situated the Dead Sea and the Sea of Tiberias. He believes that this ocean, being cut off from the Red Sea by the rise of the land at the southern extremity, and being only fed by small streams, gradually became dried by solar evaporation. He proposes to cut a canal of adequate size from the head of the Gulf of Akaba to the Dead Sea, and another from the Mediterranean, near Mount Carmel, across the plain of Esdraelon, to the fissure in the mountain range of Lebanon. By this means the Mediterranean would rush in, with a fall of 1,300 feet, fill up the valley, and substitute an ocean of 2,000 square miles in extent for a barren, useless desert, thus making the navigation to India as short as the overland route, spreading fertility over a now arid country, and opening up the fertile regions of Palestine to settlement and cultivation.

ON THE OCCURRENCE OF FOSSIL BONES IN THE AURIFEROUS ALLUVIUM OF AUSTRALIA.

In a paper presented to the London Geological Society, Mr. Clarke states that fossil bones of extinct mammalia have been found throughout a range of eleven degrees of latitude, and at heights varying from one hundred feet below to sixteen hundred feet and upward above the sea-level. The author refers to the analogous occurrence of bones in gold-drift in the Ural and in California; and in the latter country, as in Australia, this drift is frequently overspread with the products of volcanic outbursts, or with the *débris* of volcanic rocks. It would appear that a great part of the now dry land of these countries was under the water when these osseous remains were buried; and probably the destruction of these mammalia at last was connected with the final outbreak of igneous forces, which changed the horizon of considerable tracts, and introduced a state of things incompatible with the existence of these, for the most part, gigantic animals, now extinct.

ON EARTHQUAKE PHENOMENA.

The following report has been submitted to the French Academy, by M. de Beaumont, Lamé, and Lionville, charged to consider a memoir presented to the Academy, by M. Alexis Perrey, Professor in the Faculty of Sciences, at

Dijon, "On the Relations which may exist between the Frequency of Earthquakes and the Age of the Moon," and "On the Frequency of Earthquakes relatively to the times of the Moon's passing the Meridian."

The Report says:

"If, as is now generally supposed, the interior of the earth is in a liquid or pasty state, through heat, and if the globe has for its solid part only a crust comparatively very thin, the interior liquid mass must tend to yield, like the surface waters, to the attractive forces exerted by the sun and moon, and there must be a tendency to expansion in the direction of the radius vectors of these two bodies; but this tendency encounters resistance in the rigidity of the crust, which is the occasion of fractures and shocks. The intensity of this crust varies, like that for the tides of the ocean, with the relative position of the sun and moon, and consequently with the age of the moon; and it should also be noted that as the ocean's tides rise and fall twice in a lunar day, at periods dependent on the moon's passing the meridian, so in the internal fluid of the globe, there should be two changes a day, the time varying with the same cause. Without entering now into more details, it will be easily conceived that if the mobility of the internal mass of the globe plays a part in the production of earthquakes, there must be some dependence, admitting of study, between the occurrence of an earthquake and the circumstances which influence the action of the moon on the whole globe, or on any place or portion of it; that is, the angular distance with the sun, its actual distance from the earth, and its distance from the meridian of the place; or, in other terms, the age of the moon, the time of perihelion, and the hour of the lunar day. These considerations, which have not escaped M. Perrey, have, beyond doubt, inspired the idea of the twofold work which we have been charged to examine, and they have obtained for the views the interested attention of M. Arago and many other men of science. They have involved on the part of the author the determination of the precise date and period of the moon for each earhquake on record, and even for each shock of which earthquakes may consist—a work of vast labor.

"M. Perrey has tabulated all the earthquakes recorded since 1801, and 'by discussing the catalogues which he has formed, shows by three ways, independent of one another, the influence of the course of the moon on the production of earthquakes,' viz.:

"1st. That the frequency augments on the syzygies.

"2d. That the frequency augments in the vicinity of the moon's perigee, and diminishes toward the apogee.

"3d. That the shocks of earthquakes are more numerous when the moon is near the meridian than when 90° from it.

"But in each of these results he finds some 'minor' and some 'large anomalies.'

"In a recent discussion on the theory of M. Perrey, before the Boston Society of Natural History, Mr. Stodder proposed the hypothesis that the centrifugal force of the diurnal rotation of the earth, acting on the fluid interior mass (if such is the condition of the interior) of the earth, was the cause of earthquakes, and that if there has been any change in the position of the poles of

the earth, that the centrifugal force, which gives the earth its spheroidal form, in changing the form of the earth to correspond with the new position of the poles, is sufficient to account for all the geological phenomena of the fracturing of strata, elevation of mountain chains, etc.

Dr. C. T. Jackson remarked that if the sun and moon exerted a tidal action upon the fluid matters of the interior of the globe as they do upon the ocean waters, that it ought to be manifested by the rising and falling of the liquid lavas of volcanoes, especially in those great volcanic openings in the Sandwich Islands. He would ask Dr. Pickering, who was familiar with these volcanoes, whether, at Kilauea, or at any of the other craters in those volcanic islands, any regular periodicity was observable in the rising and falling of the liquid lavas, and if so, whether they correspond to the times of the moon's phases?

Dr. Pickering replied that he was not aware of any regular periods of elevation and subsidence of these lavas. He was under the impression that they were quite irregular.

Professor W. B. Rogers remarked that while there was much ingenuity in the idea of thus converting the insular volcanic mountain into a vast tide gauge for measuring the movements of the fluid nucleus of the globe, we have no right to anticipate any obvious correspondence between the fluctuations of level in the liquid of the crater and the tidal movements beneath the earth's crust. Supposing a connection to exist, the channels must be variable and tortuous, and often probably connected with cavities containing gas and vapor, and having numerous and changing outlets. From this would arise great and variable resistances, retarding, diverting, and even arresting the movement propagated from below, just as when the ocean tides are transmitted through narrow and ramifying passages, or when they reach open spaces through different channels and in opposite phases, we find the tidal phenomena greatly modified, and sometimes even entirely destroyed.

Recurring to M. Perrey's researches, Professor Rogers remarked that the results, if confirmed by a fuller indication, would be of the utmost importance to geological theory: first, by setting at rest any doubts that may exist as to the igneous fluidity of the interior of the globe; and secondly, by demonstrating the great thinness of the earth's crust, which alone could make it sensitive to the tidal movements of the molten mass beneath. Such tenuity of the crust had long since been urged by Professor H. D. Rogers and himself, as inferable from the arched and folded structure of mountain chains, as well as from the wave-like motion in earthquakes; but geologists are still far from being agreed on this and the allied points relating to internal heat. Even the general fact of an increasing temperature as we descend below the surface, although leading directly to the inference of an intense heat within the earth, has not been accepted by all as proving the existence of a *fluid nucleus*, and among those who admit the latter conclusion as demonstrated, there are many who contend that the solid crust, instead of being some 30 miles, can not be less than 800 miles in thickness. This last estimate of the thickness of the earth's crust, deduced by Professor Hopkins, of Cambridge, England, from mathematical considerations connected with the precession of the equinoxes, had apparently been accepted by Sir Charles Lyell as a basis

of geological argument, but Professor Rogers looked upon it as belonging to a class of inferences which are more of the nature of ingenious mathematical exercises on physical problems than expressions of the facts or laws of nature. Such problems often involve mechanical conditions too various and complex to be amenable even to the most profound analysis; so that to bring them within his grasp, the mathematician is compelled to resort to simplifying hypotheses, and in doing so, departs, often greatly and to an unknown extent, from the actual physical conditions of the problem. Professor Rogers maintained that conclusions so derived, however true as logical deductions from the premises, are not to be received as demonstrated physical facts. Should the correspondence of earthquake phenomena with those of the tides be confirmed by further comparisons, to which M. Perrey has been invited by the French Academy of Sciences, it would furnish a proof of the igneous fluidity of the interior of the globe, and of the yielding thinness of its inclosing shell, too conclusive to be weakened by any calculations deduced from hypothetical data.

Professor Rogers then alluded to the late experiments of Hopkins and Fairbairn, to determine the influence of pressure upon the melting point of solids. As we know that pressure augments the temperature necessary to vaporize liquids, it has become a question of interest, bearing upon the internal fluidity of the globe, to ascertain if it has a like effect upon the temperature at which solid bodies become fluid. According to Hopkins and Fairbairn, such an effect actually occurs with spermaceti, wax, sulphur, and stearine, but has not yet been detected in certain other very fusible solids experimented upon. Should it prove to be a general law, applicable also to mineral masses, which is yet far from being demonstrated, we should have to admit a higher internal temperature than would otherwise be needed to maintain the interior in a fused state; but this addition would, most probably, form but a small fraction of the whole temperature. In regard to the influence of centrifugal force in causing earthquakes, Professor Rogers remarked that such effect could only arise from a *variation* of the centrifugal force, and therefore of the earth's velocity of rotation. But the uniformity of this rotation is so nearly perfect that a change amounting to even a fraction of a second in a day, would be too startling an occurrence to escape astronomers. Hence, any variations of centrifugal force that may arise must be comprised within extremely narrow limits. Even at the equator, where this force is greatest, its proportion to gravity is very small, and when we consider that any admissible fluctuation of its intensity must be a very minute fraction of the whole force, and hardly more than an infinitesimal part of the force of gravity, the effect of such change, even at the equator, must be regarded as entirely inadequate to those extensive movements, and permanent changes of level, attending earthquakes.

At a subsequent meeting, a communication was presented from Dr. Winslow of California, who stated that he had recently spent a short time in investigating the geology of Acapulco, Mexico, and the earthquake phenomena, of which that place is peculiarly the focus. He states that he found that the shocks were more numerous there as winter approaches, and during December

and January. The earth passes its perihelion about the last day of December. His theory is, that an increasing condensation of the matter of the globe, and its contraction as it approaches the sun, augments necessarily the tension of the fluid mass embraced within its crystalline or consolidated crust. A repulsive action necessarily ensues between the molecules of the molten mass, and the mobility of this mass so acts, here and there, as to rupture the crust and allow the melted earth to insinuate itself between strata, or vertically through the entire crust, in the form of dykes, or to be forced out of volcanic openings.

NOTICE OF EARTHQUAKE WAVES ON THE PACIFIC COAST OF THE UNITED STATES.

The following communication was presented to the American Association, Providence, by Professor A. D. Bache.

On the 23d of December, 1854, at 9 A.M., an earthquake occurred at Simoda, on the island of Niphon, Japan. The harbor was first emptied of water, then came in an enormous wave which again receded. (It appeared that the whole character of the harbor of Simoda, previously surveyed by the Powhatan, had been changed by the earthquake.) A report from the Bonin Islands is not sufficiently exact to use for our main purpose, but points to Simoda as the center of disturbance. (Simoda, according to the Rev. Mr. Jones, is volcanic; Bonin appears not to be.) Now the Coast Survey has three self-acting tide-gauges—at Astoria. on Columbia River, San Francisco and San Diego. They record the rise of the tide on a cylinder turned by a clock. The apparatus is protected more or less from the oscillations that wind waves would cause, which only cause a trembling of the index or stylus. The gauge at Astoria was but slightly affected by the earthquake wave, owing to the bar on the river and the distance it had to ascend. At San Francisco, 4,800 miles from Simoda, the wave arrived 12 hours 16 minutes after the beginning of the earthquake. A series of seven waves, each about half an hour in duration, or 35 minutes, each series successively smaller, and separated by a quiet time of an hour from the preceding, was recorded at San Francisco. At San Diego the wave had traversed 5,200 miles in 12 hours 38 minutes, and produced likewise a series of seven waves, each nearly corresponding to those at San Francisco, but the second series stronger than the first and third. In height they were less, the highest at San Francisco being ·7 of a foot, at San Diego ·6. The waves at San Diego could not have come from San Francisco, as they would have arrived much later. These waves would have escaped detection by ordinary observation, being 39 feet in height only on the average at San Diego, and 44 feet at San Francisco. Three series are distinctly traceable at San Francisco, the highest wave being 65 feet in height on a tide falling two feet. The time of oscillation there was 33 minutes, and at San Diego 30 minutes. The violence of the earthquake was so great at Simoda, in Japan, as to raise a wave some 30 feet high there, and 15 feet at Peel's Island, about 500 miles to the southward. The velocity with which a wave travels depends on the depth of the ocean. The second and third series were but repetitions of the first wave that had

reached the same points, traveling through shallower water. The calculations based on these data give for the Pacific Ocean a depth of from 14,000 to 18,000 fathoms. It is remarkable how the estimates of the ocean's depth have grown less. La Place assumed it at 10 miles, Whewell at 3·5, while this estimate brings it down to about 2 miles.

At a recent meeting of the Asiatic Society, China, Dr. Macgowan read a paper on recent Physical Phenomena in China and Japan. The communication related to the earthquake at Simoda, which appears in many of its features to have resembled that which destroyed Lisbon in 1775, when the lakes of Scotland were suddenly elevated, and the sea at Madeira rose to a prodigious height. Thus, the late earthquake at Japan was followed by a rise of the inland waters of Chihkiang in China, and by an extraordinary receding and subsequent elevation of the sea at the Bonin Islands. The appearance of "white hairs," as they are styled by natives, following earthquakes in China, was alluded to; and it was suggested that they are a salt formed by the emission of vapor and sulphuric acid coming in contact probably with alumina in the earth. Notice was made also of the rise and subsidence of a volcanic island near Formosa in 1854, and of showers of dust in the China Sea.

THE ERUPTION OF MOUNT VESUVIUS IN 1855.

An interesting report on the recent eruption of Vesuvius has been made by Professor Palmieri of the Observatory of Naples. It appears that the magnetic needles, which had been slightly affected on the 29th of April, were greatly agitated on the 30th; and on the following day the eruption broke out. No fewer than ten craters opened in the course of a few hours, followed by many smaller ones, all throwing out lava and heated stones, accompanied by subterranean thunders and ruddy masses of smoke. These streams, descending into the plain, called the Atrio del Cavallo, formed there a sea of fire, whose shores were on either side the mountain of Somma and the lava of 1850. Early in the progress of the eruption, the lava was 100 palms in depth; and it was considered that if another such an accumulation took place, which certainly has now happened, the Hermitage and the Observatory would be in danger.

The magnetic apparatus of Lamont was used by Professor Palmieri on the occasion of the earthquake of Melfi; and the results were such as to induce him to think that it would not be mute, as the event has proved, on the occasion of an eruption of a volcano. Anticipating, as it has done, such a catastrophe by several days, it is one of the most beautiful and convincing proofs of the practical applicability of science to the service of human beings that modern days has furnished us with. Passing from magnetism to electricity, Professor Palmieri says that on the first day of the eruption observations were impossible; but, on the clouds clearing off, he ascertained that there was a great tension of positive electricity, which increased considerably on the fall of some ashes on the evening of the 2d inst. In general, the electricity was always stronger when the wind blew toward the Observatory. It manifested itself very vigorously to the movable conductor, not always to

the fixed conductor; "and, during the fall of the ashes," he says, "I verified a curious fact, which I have observed during the fall of rain, also, that while with the movable conductor we had positive electricity, with the fixed conductor a faint, negative electricity was observed." This eruption is described as having been extremely grand, and many interesting observations were made respecting it. A correspondent of the London Athenæum thus describes the course of lava:—"It was pent within the deep banks of a wide bed, and was flowing down, not like a fluid, which is the ordinary motion of it, but like a mountain of coke, or at times like highly gaseous coal. It split, and crackled, and sparkled, and smoked, and flamed up, and ever moved on in one vast compact body. Pieces, detaching themselves, rolled down, leaving behind a glare so fierce, that I could have imagined myself at the mouth of an iron furnace; and as every mass fell down with the noise of thunder, or rolled sideways from the upper surface into the gardens and vineyards, the trees flamed up, and the crowds uttered shouts of admiration and regret. Following the course of the stream, or rather tracing it back to its source, we walked by the side of that huge leviathan, through highly-cultivated grounds, now trodden under the feet of multitudes, until we arrived at the edge of a precipice, whence we looked into the boiling flood, fed by the cascade of lava, which was pouring down from above. The sublimity of that spectacle is indescribable; and, were I to live the life of Methusellah, the impression it made upon me would never be obliterated. I can think of nothing else; and when I close my eyes, still the stream of fire dazzles my sight. Full 1000 feet fell that glowing, flaming Niagara, in one unbroken sheet, over the precipice at the back of the Hermitage and the Observatory. Forming, at first, two cascades, the interval between had been filled up by the immense masses of scoriæ, which the mountain had thrown out; and now it majestically rolled down one continued stream into a lake of boiling fire, and then descended into the plains which it had left. There were times when projections in the face of the lava seemed to impede its course, or when the adhesive character of it appeared to bind it up in a temporary rigidity; then, behind those projections, accumulated tons upon tons of material. It was a moment of breathless expectation; all eyes were fixed upon that one blackened spot. There was a slight movement; one heard a click; a few ashes and stones fell down like *avant-couriers*, and down went a mountain of solid fire into the boiling, smoking abyss, with the noise of thunder."

EARTHQUAKE INDICATOR.

Dr. Kreil, formerly Director of the Observatory at Prague, has invented an ingenious instrument to measure the force, duration, and direction of earthquakes. It consists of a pendulum, so contrived that, while it can move in any direction, it can not return. A perpendicular cylinder is attached, which, by means of clock-work, turns on its vertical axis in twenty-four hours. A pole, with a thin elastic arm, is fixed near the pendulum; this arm points toward the cylinder, and presses on it gently a pencil, by which means an unbroken line is formed on the surface of the cylinder as long as the pendulum

is at rest; but, if it is put in motion by an earthquake, the pencil makes broken marks, which show the strength, direction and period of the earthquake.

ON SUPERFICIAL CHANGES IN THE MERIDIONAL STRUCTURE OF THE GLOBE.

At the last meeting of the British Association Mr. E. Hopkins read a paper on the meridional and symmetrical structure of the globe, its superficial changes, and the polarity of all terrestrial operations. This paper was illustrated by maps and diagrams, including a section, on a large scale, of the Cordilleras, from the plains of the river Meta to the shores of the Pacific Ocean. Among other speculations, he said that 9,000 years ago the site on which London now stands was in the torrid zone, and, according to perpetual changes in progress, the whole of England would in time arrive within the Arctic circle.—The views of the expositor were stongly controverted by Professor Ramsay and Professor Nicol.

MODERN ELEVATION OF LAND.

General La Marmora, who has been employed twenty-four years on a geographical and geological survey of Sardinia, recently presented an outline of his researches in the latter department to the Geological Society of France. In this paper he states that near Cagliari he found a raised beach containing shells mixed with works of human art (pottery), at an elevation of 197 feet (60 metres) above the sea. It seems to be slightly *inclined;* and he speaks of another deposit, probably a newer one, a little further on, which is horizontal and almost at the level of the sea. He estimates that at Alghero, 100 miles N.N.W., the rise produced by the same upheaval has been 328 feet, not attested however, by human remains, but by the position of a "quaternary sandstone." The extreme rarity of raised beaches containing such remains renders these facts interesting. Mr. Lyell refers only to three—"one which I have seen, at Putzuoli, 20 feet above the present sea level; another near Stockholm, 60 feet above it, and a third in Peru, seen by Mr. Darwin, 85 feet. It now appears that some parts of Sardinia have been upheaved 197 feet since the island was occupied by man."

ON THE EXISTENCE OF ACARI IN MICA.

At the British Association, Sir David Brewster stated that while recently examining with a microscope a thick plate of mica from Siberia, about five inches long and three inches wide, he was surprised to observe the remains of minute animals, some the 70th of an inch, and others only the 150th of an inch in size. Some of these were inclosed in cavities, round which the films of mica were in optical contact. These acari were, of course, not fossil, but must have insinuated themselves through openings between the plates of mica, which afterward closed over them.

REVENUE OF COAL ESTATES.

Comparatively few have an adequate conception of the magnitude and real value of the coal estates of the three great anthracite regions. In Schuylkill county, where operations have been carried on more extensively, and for a longer period than elsewhere, the revenue derived is truly astonishing. From a single tract of 200 acres, in that county, the income, since 1836, we have been informed, has averaged $18,000 per annum. This is but one of many cases that have come to our knowledge. There are, indeed, other estates that yield even more abundantly. In the Luzerne region, the profits that attend mining operations are equally remarkable. The Baltimore Company, located two miles from Wilkesbarre, cleared in 1853, $60,000. Their investments in lands and machinery have been but $130,000—which, therefore, is returned to the stockholders every two or three years. The Pennsylvania Coal Company, in the same region, though laboring under great disadvantages in the shipment of coal, netted the same year, $330,000. The coal department of the Scranton Company, also, during the same time, cleared a profit of $76,000 upon but 100,000 tons mined, although most of their large expenditures for development were increased during this period.

Waste of Coal.—Mr. Holmes, in his *Treatise on Coal Mines*, states the waste of small coal at the pit's mouth to be one fourth of the whole. The waste in the mines is computed to be one third.—*Mining Journal.*

ASCENT AND MEASUREMENT OF MOUNT HOOD.

The California papers give an account of the ascent of one of the Oregon Peaks, known as Mount Hood, which has been ascertained by measurement to be 18,361 feet. This is the highest peak on the North American continent, and one of the highest in the world. The mountain was ascertained to be volcanic, smoke being seen to issue from the summit. The peak of Mount Hood is thus described:

"We found the top similar to that of Mount Helen—extremely narrow, laying in a crescent shape. Mount St. Helen's facing the northwest by a crescent, while Mount Hood's faces the southwest. The sharp ridge on top runs from the southwest to the north, making a sharp turn to the west at the north end. The main ridge is formed of decomposed volcanic substances, of a light reddish color, with cones from twenty to fifty feet high at intervals of a few rods. These cones or rocks are full of cracks or fissures, as if they had been rent by some convulsion of nature at a remote period. Between these cones there are numerous holes, varying from the size of a common water bucket down to two or three inches in diameter. Through these *breathing holes*—as we shall call them—and through the crevices in the rocks there is constantly escaping hot smoke or gas of a strong sulphuric odor. In passing over the ridge for near half a mile we discovered a large number of these breathing holes; through some the heat was more intense than in others.

"We did not carry up a thermometer; therefore, we could not get the ex-

act degree of the heat; but from holding our hand over several of them, we have no doubt that the thermometer would have shown 'boiling heat' in some of them."

MANUFACTURE OF SALT IN THE UNITED STATES.

It is known that in the south-eastern part of Ohio, salt water is found abundantly; but heretofore the water has been found too weak to compete successfully, for more than local use, with the salines of Kanawha, or of Syracuse. Hence the quantity manufactured in Ohio has been comparatively small. But of late the tables are likely to be turned. The difficulty in the old wells was, in not boring deep enough. The real saliferous rock in that region, lies about 1,000 feet in depth. The old wells were generally dug about 400 or 500 feet in depth. They got water but it was not the original springs, but a diluted quality. Recently, however, boring has been carried to the salt-bearing rock, and salt water in great abundance is obtained, and of strength sufficient to compete with other western salines. The most successful experiments of this kind have been made at Pomeroy, Ohio, where wells have been sunk to the depth of 1200 feet. The strength of the brine is from 9° to 10° B. From some of the wells sufficient carbureted hydrogen gas issues to supply the furnaces with a large amount of fuel. From a well at Coalport, Ohio, there is at times a copious flow of petroleum. The greater portion of this mineral oil is sold at 25c. per gallon for the purpose of making the patent medicine "*Mustang Liniment.*"

The product of salt in Ohio, according to the census of 1850, was 550,350 bushels. The amount estimated for the year 1855 is 1,300,000 bushels, which exceeds the product of any State, except New York and Virginia.

REMARKABLE BRAZILIAN DIAMOND.

The largest and finest diamond which has as yet been found in Brazil, has recently been imported into Paris, and has received the name of the "Star of the South." In its rough state it weighs 807.02 grains, or 254½ carets. When cut it will be reduced to about 127 carats, and will therefore exceed the Koh-i-noor in size. Independently of its magnitude, it possesses much scientific interest from the regularity of its crystalline forms, and the indication it affords of the mode in which the diamond occurs. The general form of the "Star of the South" is a rhomboidal dodecahedron, having each of its faces beveled by a face set on very obliquely, so that it has in all 24 faces. On one of its faces there is a pretty deep cavity obviously produced by an octahedral crystal which has been implanted in it. The interior of this cavity when examined with a lens shows octahedral striæ, and it can not therefore be doubted that the crystal which has left its trace was a diamond. On the posterior face of the crystal there are two other cavities of less depth also showing striæ, and one of them even exhibits traces of three or four different crystals. On the same side of the crystal there is a flat part where the cleavage appears, and which M. Dufrenoy considers to be a fracture, and possibly as the point by

which the diamond was attached to its matrix. From these facts it appears that the "Star of the South" has been only one of a group of diamonds similar to the groups of rock crystal, coal spar, or any other crystalline mineral —*Compte Rendus*, vol. xl., p. 3.

ON THE DISTRIBUTION OF IRON.

Mr. J. D. Whitney in a communication to the American Association, Providence, remarked that there were scattered over the earth deposits of iron of peculiar character and extraordinary purity, and that the mode of their occurrence was also peculiar; they belonged to certain systems of rocks, and were found only in those systems. The principal localities in which this iron occurred were Scandinavia, Northern New York, Superior and Missouri. In Sweden there was a single bed 700 feet in width by four or five miles in length. The deposits in northern New York were not so extensive, but the Cleveland Iron Mountain in the Lake Superior country rose to the height of 1,039 feet above the lake, with a breadth of 1,000 feet, and was entirely composed of iron ore. Along its summit were numerous knobs 50 to 100 feet in height, which were perfectly pure. There were numerous other mountains in Missouri which furnished equally pure ores. The ores thus found were almost always of two kinds, specular and magnetic. The specular predominated in Sweden, Superior and Missouri, while the magnetic prevailed in northern New York. In Superior the iron beds lay between trap and talcose slate; in Missouri porphyry was near; in New York it seemed to have been sedimentarily deposited in lenticular masses, and afterwards subjected to metamorphic action; these all in azoic rocks. As the azoic periods were more violent in their action than later periods, it was probable that what was thrown up during those periods came from a deeper portion of the earth, and we might hence infer that there were great deposits of pure iron deep down in the earth.

Professor Hall in reply to a question, stated, that all the rocks below the paleozoic, which occurred in any considerable quantities in this country, were metamorphic from sedimentary rocks. Not only the great systems of these rocks, but even subordinate portions of them had been deposited under somewhat different circumstances physically and chemically. Although some shells and sandstones in different formations might have considerable similarity, still they presented differences, and these slight differences were brought in metamorphism. He was satisfied that when our metamorphic rocks came to be more thoroughly known, every group that had had any considerable characteristic in its original formation would in its metamorphoric state be found to present such peculiar minerals as to characterize it as perfectly as the fossiliferous rocks are characterized by their fossils.

ON THE OCCURRENCE OF NATIVE IRON IN LIBERIA.

During the year 1853, a specimen of malleable iron was sent from the vicinity of Bexley, Bassa County, Liberia, to William Coppinger, Esq., of

Philadelphia, with a letter from the Rev. Mr. Davis, of Liberia, in which he says:—"I have seen and conversed with a number of natives, who affirm that it is actually the pure ore, or just as broken from its native bed." This specimen, during the past year, was placed in the hands of Dr. A. A. Hayes, of Boston, by Rev. Joseph Tracy, for chemical examination. This examination by Dr. Hayes brought to light the remarkable fact that the iron in question was pure native iron, not meteoric, but probably occurring as a deposit by itself, unalloyed with any other metals. The following is the report of Dr. Hayes on the subject:—

The specimen had been drilled and filed when I first saw it. The filed surface arrested my attention, as the arrangement of the particles of the iron resembled that of the unalloyed part of meteoric iron, and was unlike that of any iron that had been hammered or rolled. Artificial iron is presented to us under two forms; first, that of crude or cast iron, which, always granular, is brittle, though sometimes malleable in a slight degree; second, wrought or ductile iron, the product of refining either cast iron, or as the result of skillful reduction from an ore, in a forge fire, by alternate heating and hammering. In either case, the particles of the iron have certain definite forms, arranged as crystals in the cast iron, which are broken down and rearranged in the ductile iron, as plates, or scales, or longitudinal fibers.

The native iron presents only very minute crystalline grains, which have not been broken or blended. Their color is lighter gray than that of any hammered iron. They are without much luster, resembling iron which has been aggregated by electrical deposition. The mass is tough; and when a fragment is broken, repeated bending and doubling is required, and the fracture is hackly. The texture is not uniform. Some parts are less compact than other portions, rendering the specific gravity of the mass less than that of other iron. This inequality is due in part to the presence, in the mass, of crystalline quartz, magnetic oxyd of iron, and a zeolite mineral, having a soda basis in part; conclusively proving that the iron has never been melted artificially.

Its chemical composition is—

Pure iron,	98·40
Quartz grains, magnetic oxyd, Iron crystals, and zeolites.	1·60
	100·00

There are no other metals present: a fact which prevents us from placing this iron in the class of meteorlites. And the *absence of carbon* in any form removes all doubt in regard to its being possibly of artificial formation.

Every form of iron which has been the subject of manufacture, contains carbon. And it is an interesting observation in this connection, that, in the large number of samples of ancient irons and those produced by semi-civilized people, which I have analyzed, not only has carbon been present, but the proportion was always larger than exists in the iron of commercial people. It appears that the rude workmen, in producing this useful metal, stop at that point where the half-refined iron is sufficiently ductile to take, under the

hammer, the required form; while the purer irons are produced later in history, when the more highly prized qualities become known.

The evidence which has been collected respecting the locality and history of this iron tends to show that the natives of the vicinity have drawn their supplies from it for many years. Various implements are now in the United States which have undoubtedly been manufactured from native iron.

Mr. Davis says, in the letter accompanying this specimen: "I am told by the natives that it is plentiful, and about three days walk from our present residence. It is obtained by digging, and breaking rocks. It is also said to be in large lumps. In these parts, the natives buy no iron, but dig it out of the ground, or break the rocks and get it, as the case may be."

The Rev. John Seys, in a letter published in the *African Repository* for June, 1851, says:—

"Such is the purity of the iron ore obtained by the natives of Africa in the immediate vicinity of Liberia, and which they represent as being abundant, that they have no furnaces. They need none. All their rude agricultural and warlike instruments are made by them of ore so pure that, when heated, it becomes sufficiently malleable to admit of being wrought into any shape or form. They make knives, bill-hooks, war-cutlasses, spears, axes, hoes, etc., out of this ore, without the process of smelting."

Mr. James Hall, under date of July, 1855, writes:

"The natives manufacture iron in quantities in the interior. It is very soft and pure. I have often been told by the beach natives who have traveled inland, that 'they take plenty wood and coal; make a big pile; put tone (stone) on him; then more wood, more coal, and more tone; then set him on fire, and burn him trong, two, three days; then iron come up.' This is the talk all along the shore; that is, the *reliable* talk. Although many say they find the pure iron, I am sure no pure iron was ever found in Liberia or its vicinity in any considerable quantity, before I left in 1840."

Strictly speaking, Mr. Tracy remarks, an "ore" is a rock composed of or containing a metal in chemical combination with some other substance. "Smelting" is the reduction of a metal in an ore by the application of heat to its metallic form. A fire like that described above could never produce a heat intense enough to "smelt" any ore of iron; and besides, the result of smelting iron ore is always *cast* iron, and not malleable. But if in "breaking the rocks," the rocks should not readily yield to blows, it would be a very natural device to place it on a very hot fire. The result would be that the rock would crack into pieces and the iron would be released; and being heavier than the decrepitated stone, it might, especially if stirred a little, fall together and become welded into one mass. This, beyond all question, is the usual process in the mountainous regions south of St. John's River.

Mr. Tracy further says: There is reason to suppose that native iron exists in other parts of Africa, especially the western—Adanson, a French naturalist, whose "Natural History of Senegal" was published in the latter part of the last century, asserts that the natives of that region make implements of it. A description, probably derived from him, of the native iron of Senegal, applies well to the lumps found on the "New Jersey purchase" and at False Cape.

Further south and east, beyond the Niger, the Rev. J. L. Wilson found that the Pangwe people, who are gradually migrating from the inland mountains toward the coast near the equator, have "iron of their own," of superior quality, usually in "pieces about the size, and somewhat in the shape of a horse-fleam, and probably produced from lumps of native iron of nearly uniform size." At Loando, about nine degrees south, the natives of the interior sell iron implements of their own manufacture for European goods, at prices less than the cost of the European iron which would be required to make them. In South Africa, the Rev. Dr. Adamson, long a missionary there, informs me, meteoric iron is abundant; but whether it has been found to be meteoric by analysis, or only presumed to be so, because all native iron has hitherto proved so, I am not informed.

The existence of native iron has often been asserted. Pallas was said to have found it in Siberia, and others in South America, New Mexico, Virginia, and other regions. But all these, so far as they have been analyzed, have proved to be meteoric. The native iron of Liberia, therefore, is a substance perfectly new to the world of science and of art. Its existence in large deposits is as probable as was that of native copper before the opening of the mines on Lake Superior. Native copper had been known for ages to exist; but till the opening of those mines, it had never been found in quantities sufficient to be of much commercial importance. Now, it is found in great abundance, and some of it in masses so immense that the miners are troubled with their vastness. Whether the native iron of Liberia exists in similar abundance, can be determined only by an actual examination of the country. But if large quantities can be found at the water's edge, or even twenty-five miles inland, its commercial value must be immense.

Native Iron of Canaan, Connecticut.—In all the minerological works published during the last few years, native iron has been registered as occurring at Canaan, Conn. The authority for this statement rested on a single specimen preserved in the cabinet of Yale College. After the results of the examination of the Liberian iron by Dr. Hayes were made known, a portion of this specimen was placed in his hands by Professor Silliman for examination. Dr. Hayes has since shown, in the most indubitable manner, that the Canaan iron is cast-iron, containing charcoal, plumbago, and other impurities.

ON THE PRODUCTION AND CONSUMPTION OF METALS AND OTHER MINERAL PRODUCTS IN GREAT BRITAIN.

From the report of Robert Hunt, keeper of the mining records of Great Britain, for the year 1854, we derive the following statistics respecting the production and consumption of metals and other mineral products in Great Britain:

The total quantity of tin ore raised in Cornwall and Devonshire in 1853 was 8,866 tons, the average value of which was about £68 per ton. The black tin, or tin ore, produces on the average 65 per cent. of metallic, or white tin, as it is called. The quantity of this metal of British produce brought into the market, is about 6,000 tons annually. The annual importations of tin into

Great Britain from Singapore, India, China, Peru, and Brazil, amounts to 2,500 tons. Of this foreign tin there is re-exported about 1,000 tons, and of British tin rather more annually. The average production of the five largest tin mines of England for 1853 was about 250 tons, the maximum produce being 282 tons.

Out of the tin produce arises another, but not very extensive, branch of mineral industry—the production of arsenic; most of the tin ores contain both that substance and sulphur, which are got rid of by exposing the powdered ores in peculiarly constructed furnaces to the action of fire. The quantity of arsenic annually produced has been estimated at 2,000 tons; the chief market for it is, however, now closed, the principal portion of it having been used in the preparation of Russian leather.

In 1853 the value of the copper ore sold in Cornwall was £1,155,167; and, in addition to this, Ireland produced 11,278 tons of copper ore, and some hundreds of tons were produced in Wales and the northern English counties. The importance of some scientific knowledge to the mining population is well exemplified by the fact, that hundreds of tons of the gray sulphuret of copper have been thrown over the cliffs of the western shores into the Atlantic Ocean, and hedges have been built with copper ores of twice the value of the ordinary copper pyrites. Immense masses of the black oxyd of copper had from time to time been thrown aside; eventually, the miner became acquainted with the value of these ores, and they are now, of course, carefully preserved whenever they occur.

Mr. Hunt gives some details of the produce of the principal copper mines in Cornwall, whence all the copper ore raised is sent to Swansea, the trade employing about 150 vessels and 800 seamen. The ships carry back coal to Cornwall, which is employed chiefly in the production of the mechanical force by which the water is pumped from the mines and the ores raised. The smelting establishments of Swansea support, by their direct or indirect influence, nearly 15,000 people: thus we have an example of the effects of a peculiar branch of industry rising up at a distance from the locality in which the material sought for is produced. The importation of copper ores from the mines of Cuba, Chili, etc., would, it was feared, greatly reduce the value of the British ore. Now, although Cuba exports to England 15,000 tons of her rich ore annually, Chili at least 18,000, and Peru, Spain, South Australia, and our other colonies, about 20,000 tons more, the value of the Cornish copper ores have steadily increased, the combination of the two being necessary for the production of the best kinds of metal.

Mr. Hunt describes the Cornish pumping-engine as, perhaps, the best example of the application of steam as a motive-power which the world had yet produced. This superiority he attributed to the necessity imposed upon the engineers of effecting a great economy of fuel, in a locality so far distant from the coal-fields; and, again to the circumstance that the duties of the engines were regularly reported in what are called "duty papers." The duty of a Cornish pumping-engine is estimated by the number of pounds lifted a foot high by the consumption of a bushel of coals. Taylor's engine, at the United Mines, reached the high duty of lifting 110,000,000 pounds. The average

duty of all the engines at present at work is 51,620,000, while the average duty of the best engines amounts to 99,000,000. This enormous power, which may be estimated at equal to the power of 5,500 horses, is employed to raise more than 9,000 gallons of water per minute from the mines, and to lift a large portion of the ore which is raised. The manufacture of these engines gives rise to other and important industries, each of these large engines costing from £2,000 to £4,000. The machinery at one of the largest mines in Cornwall has been estimated to be of the value of £75,000. From estimates which have been carefully made it appears that nearly 30,000 persons were employed in and about the Cornish mines; of these 5,500 were women, and 5,000 children, the women and children being employed on the surface only. In one way or another at least 100,000 persons derive their means of subsistence from the tin and copper mines of western England.

The production of lead from the English mines, for 1853, was 85,121 tons of ore, or 61,021 tons of lead. Most of this lead contains silver which is now profitably extracted. The average produce of silver from the lead ores of Devonshire is 40 ozs. to the ton, those of Cornwall 35 ozs., those of the Isle of Man 20 ozs., of Wales about 15 ozs., of Ireland 10 ozs., and of the northern counties about 6 or 7 ozs. Formerly it was not profitable, by the processes adopted—the oxydation of lead—to separate the silver when it existed in less proportions than 15 ozs. to the ton. By the process of desilveration introduced by Mr. Pattinson, it is now economical to separate the silver when not more than 5 ozs. exist in a ton of lead. From this process an enormous amount of wealth has been added to the national store, and there is now obtained from British lead ores at least 700,000 ozs. of silver, which may be valued at £92,500. A process has lately been introduced in which zinc is employed in combination with the fused metal: by the action of affinity the silver is thus readily separated, but as yet this process is not extensively employed.

Zinc mining receives but little attention in England, nearly the whole supply of the British Islands being derived from Belgium.

In the working of manganese the English are not able to compete with the German mines.

The clays of Great Britain are in the highest degree valuable; the amount raised in 1853 being upward of 100,000 tons.

During the year 1853 the whole number of iron furnaces in blast was 550, and the total product nearly reached 3,000,000 tons.

The exact quantity of coal raised is not accurately known; many of the proprietors of mines declining to furnish information. Mr. Hunt estimates the amount for the year 1853, at about 60,000,000 tons, having a value at the mouth of the pit of £11,000,000, and at the place of consumption of £18,000,000. In producing this quantity 233,650 workmen were employed under ground, and about 50,000 on the surface. Mr. Hunt estimates the quantity of coal remaining in the great English coal-fields of Northumberland and Durham, to be equal to 1,251,232,504 Newcastle chaldrons of 53 cwts. each. By this estimate, at the present rate of demand, these coal-fields will be exhausted in 331 years.

The manner in which the coal raised in England *alone*, during the year 1853, was disposed of, is estimated as follows:

For household purposes, about	19,000,000 Tons
For iron-works	13,000,000
For steam, gas, and coking coal	9,000,000
Export	4,000,000=45,000,000

The value of all the raw material produced from the British mines during the year 1853 is given as follows:

Coal, at the pit's mouth	£11,000,000
Iron	10,000,000
Copper	1,500,000
Lead	1,000,000
Tin	400,000
Silver	210,000
Zinc	10,000
Salt and other minerals	400,000=24,520,000

In this estimate neither clays, lime, or the produce of stone-quarries, are included, which will augment the sum given above to at least £30,000,000, and when the cost of labor employed in converting this mass of matter into articles of utility or objects of ornament is added, it will be swelled a hundred-fold.

MINERAL WEALTH OF THE LAKE SUPERIOR DISTRICT.

The immense wealth and the vast importance of the Lake Superior iron and copper region, is every day becoming more apparent to intelligent, discerning men. New discoveries of copper deposits, and new developments of the wonderful mineral wealth of this region, are constantly being made. Almost every mail from Lake Superior brings us additional intelligence calculated to increase and strengthen the public confidence in the vast resources of the copper regions. In 1854 a mass of pure native copper was found in one of the mines, of a weight of not less than 212 tons, and during the past season the discovery of another mass, weighing 250 tons, and worth in market $175,000, has been chronicled. These, of course, are not every day discoveries, but they will serve to give some idea of the inexhaustible extent of the copper deposits of the Lake Superior mineral region. In 1853 the produce of the copper mines of Lake Superior was estimated at 2,800 tons, and those of the iron mines to over 810 tons of blooms and 405 tons of ore. The capital invested in thirty-four copper-mines which have lived through or have been established since the era of wild speculation, amounts to $2,120,000, and represents a market value—constantly increasing—of $7,033,500. The best authorities estimate the production of copper for the last season, putting it at the lowest mark, at 3,600 tons. Though these statistics leave out of view the heavy losses incurred in opening mines which have proved worthless—losses of which we have no exact statements, but which we presume would show

that the whole course of operations in that region has by no means been so profitable as would else appear—still the history of legitimate mining operations affords no other example of such an extraordinary development of the mineral wealth of a country. Nine years ago the entire southern shore of Lake Superior, nearly equal to the sea-coast of New England, was an unbroken wilderness, save where the missionary had collected a small band of natives into a settlement, or the Ojibways had formed their camping-grounds during the fishing season. Yet that district promises for this year shipments of copper equal in amount to one third of the entire produce of the English mines during the same period—mines, the productiveness of which is increased to the highest possible limit by the science and experience of centuries, a profusion of capital, cheap labor, and the market of immense manufacturing districts, and, in fact, of the world.

The imagination hardly dares conceive the results of another nine years' operations on Lake Superior, now that the difficulties incident to the opening a new country and to the establishment of a new commercial interest have been overcome, and mining placed upon a firm, scientific, and industrial basis. In considering the great prospective increase of the mining interests in question, it must not be forgotten that the explorations of each successive year, beside developing new veins and deposits upon land already occupied by companies, are extending continually the limits of both the copper and iron producing districts. At first, but a few points upon the Keweenaw Peninsula, and a spot or two near the Ontonagon, were known. Now the entire range from Copper Harbor to some distance west of the Ontonagon has passed into the hands of mining companies. Last season the advanced posts had reached Agogebic Lake, and their labors had so much of success that they have now gone beyond that lake, and new companies are forming at this very time to commence upon that part of the range; and that, too, with prospects as encouraging as those upon many locations now considered of established value. We also hear of successful explorations still further West.—*N. Y. Tribune.*

Since the writing of the above, nearly complete returns from the various Lake Superior mines have been received, and the amount of copper produced exceeds the estimate by more than a thousand tons. The quantity mined and sent to market, or in a state ready for shipment in the various districts, is as follows:—In the Ontonagon district, 2,190 tons; in Keewenaw district, 2,225 tons; in Portage Lake districts, 345½ tons; making a total of 4,790½ tons, or 9,581,000 lbs. of copper as the total yield of the range for 1855. This, at the present prices, is worth over $1,600,000.

The produce of the Cliff Mine was 1,600 tons; of the Minnesota, 1,350; and of the North American, 265.

ON THE DISCOVERY OF A FOSSIL TREE WITHIN THE ARCTIC CIRCLE.

Sir Edward Belcher, at the Glasgow meeting of the British Association, gave the following description of the trunk of a fossil tree discovered erect as it grew within the Arctic Circle, in 75° 32′ N., 92° W., or immediately

to the northward of the Narrow Strait which opens into the Wellington Sound:—

Having dispatched several shooting parties in quest of hares and ptarmigan, one commanded by the boatswain returned about midnight, on the 12th of September, 1853, bringing a report that they had discovered the heel of the topgallant-mast of a ship in an erect position, about one mile and a half inland; and the carpenter's mate, one of the party, asserting that it was certainly "a worked spar," of about eight inches diameter, seemed to confirm this report. Such a communication from such authorities—considered of sufficient importance to awake me, startled me not a little. One point, however, was not so clear to my imagination—it was too far inland, and, moreover, in a hollow. On the morrow I proceeded, accompanied by the boatswain, armed with picks and crows, to search for and bring in this discovery; but it was not without great difficulty that it was rediscovered, snow having nearly obliterated the footmarks of the previous day. I at once perceived that it was not a mast, nor a worked spar, nor placed there by human agency. It was the trunk of a tree that had probably grown there and flourished, but at what date who would venture to determine? At the period when whales were thrown up and deposited, as we found them, at elevations of 500 to 800 feet above the present level of the sea, and the land generally convulsed, and also when a much higher temperature prevailed in these regions, this tree probably put forth its leaves, and afforded shade from the sun. Such a change of climate just then would have been peculiarly acceptable! I directed the party which attended me to proceed at once to clear away the soil, then frozen mud, and splintering at every effort like glass. The stump was at length extracted, but not without being compelled eventually to divide the tap root; and collecting together the portions of soil which were immediately in contact, and surrounding the tree, in the hope of discovering impressions of leaves or cones, the whole was carefully packed in canvas, and eventually reached England. Near to the spot in question, I noticed several peculiar knolls, from which I was led to infer that other trees had grown there; and I caused them to be dug into, but they proved to be peat mosses, about nine inches in depth, and, on closer examination in my cabin, proved to contain the bones of the Lemming, in such extraordinary quantity as to constitute almost a mass of bony manure. Through the kindness of Dr. Hooker, the entire matter having been forwarded to Sir. W. Hooker, at Kew, I am enabled to furnish the following interesting remarks:—"The piece of wood brought by Sir Edward Belcher from the shores of Wellington Channel belongs to a species of pine—probably to the *Pinus* (*Abies*) *alba*, the most northern conifer. This, the 'white spruce,' advances as far north as the 68th parallel, and must be often floated down the great rivers of North America to the Polar Ocean. The structure of the wood of the specimen brought home differs remarkably in its anatomical characters from that of any other conifer with which I am acquainted. Each concentric ring (or annual growth) consists of two zones of tissue; one, the outer, that toward the circumference is broader, of a pale color, and consists of ordinary tubes of fibers of wood marked with discs common to all coniferæ. These discs are usually opposite one another when

more than one row of them occur in the direction of the length of the fiber, and what is very unusual, present radiating lines from the central depression to the circumference. Second, the inner zone of each annual ring of wood is narrower, of a dark color, and formed of more slender woody fibers, with thicker walls in proportion to their diameter. These tubes have few or no discs upon them, but are covered with spiral striæ, giving the appearance of each tube being formed of a twisted band. The above characters prevail in all parts of the wood, but are slightly modified in different rings; thus the outer zone is broader in some than in others, the disc-bearing fibers of the outer zone are sometimes faintly marked with spiral striæ, and the spirally marked fibers of the inner zone sometimes bear discs. These appearances suggest the annual recurrence of some special cause that shall thus modify the first and last formed fibers of each year's deposit, so that that first formed may differ in amount as well as in kind from that last formed, and the peculiar conditions of an Arctic climate appear to afford an adequate solution. The inner or first formed zone must be regarded as imperfectly developed, being deposited at a season when the functions of the plant are very intermittently exercised, and when a few short hours of hot sunshine are daily succeeded by many of extreme cold. As the season advances the sun's heat and light are continuous during the greater part of the twenty-four hours, and the newly-formed wood fibers are hence more perfectly developed; they are much larger, present no signs of striæ, but are studded with discs of a more highly organized structure than are usual in the natural order to which this tree belongs."

At a recent meeting of the Geological Society, London, Sir R. J. Murchison stated that from an examination of the geological specimens brought home by the recent various English Arctic expeditions, he inferred that the oldest sedimentary rock of the Arctic archipelago is the Upper Silurian limestone, which contains several corals and other fossils known in the formations of that age in Gothland, Wenlock, and Dudley. No clear evidence has been afforded as to the existence of Devonian rocks, though extensive masses of red and brown sandstone may belong to that formation. True carboniferous *Producti* and *Spiriferi* have been brought home by Sir E. Belcher from Albert Land, north of Wellington Straits; and coaly matter has been detected in many localities. Secondary rocks, it is surmised, may exist in the smaller islands north of Wellington Channel, as fossil bones of saurians were found in them. As there are no clear traces of the older tertiary rocks, the author inferred that the older deposits of the Arctic region had been elevated at an early period, and had remained in that position during a very long time; for the objects to which the attention of the geologist is next drawn by the collections of the voyagers, are certain silicified stems of plants, which are widely spread over all the islands, between Wellington Channel and the east and west coasts of Banks's Land, and which, from the examination already bestowed on them by Dr. Hooker, appear to be allied to, if not identical with, coniferous trees. At one spot, namely, Coxcomb Range, Banks's Land, and at a height of 500 feet above the sea, Captain M'Clure collected a large *Cyprina*, undistinguishable from *C. islandica* of the glacial drift of the British isles. There are small

stems of plants, some of which exhibit passages from a silicified condition to that of lignite and of wood, and numerous fragments of which seem to be referable to existing species of coniferæ. Most of the specimens were buried in frozen mud or silt, and these have preserved, during a long period, their woody fiber in a natural condition. Attention was particularly directed to the portion of a trunk of one of these fir-trees, three feet six inches in circumference, which had been procured by Captain M'Clure from a ravine in Banks's Land, where much of the wood is strewed about, in different states of preservation, at heights varying from 300 to 500 feet above the sea, together with cones apparently belonging to an *Abies*, resembling *A. alba* (a plant living still within the Arctic circle). One of Lieutenant Pim's specimens of wood from Prince Patrick's Island is of the same character, and much resembles *Pinus strobus*, or the American pine, according to Professor Quekett, who refers another specimen, brought from Hecla and Griper Bay, to the larch. Having alluded to the fact of the remains (including entire skeletons) of whales having been found by Sir E. Belcher to the north of Wellington Channel, at considerable heights above the sea, the author inferred that the existence of the remains of these animals, with those of fir-trees of considerable size, in latitudes ranging from 74° to 78° 10′, could be most easily explained by supposing that the greater portion of this region was submerged, when the remains of whales and the *Cyprina* were lodged on a former submarine surface, and when quantities of wood were floated or carried by ice-floes (accompanied by much silt and detritus) from the mouths of the nearest great rivers; a subsequent elevation of such sea-bottom having produced the present relations. At the same time he admitted that a case which had been brought to his notice by Sir E. Belcher, might induce some persons to believe that the trees grew upon the spot where their remains are now found; since that officer examined a trunk in lat. 75° 30′ north and lon. 92° 15′ west, which he states to have been in a vertical position, with its roots extending downward into a clayey and peaty soil with sand. Remarkable as this case is, and leading, as it might, to the inference that a very different climate prevailed here when such vegetation existed, the author prefers the simpler view above mentioned to one which would necessarily involve the hypotheses of —1. A much warmer climate, at a time when these Arctic lands were high above the sea. 2. A depression to the extent of several hundred feet, to account for the distribution of Arctic marine animals over the surface; and 3dly, another elevation to bring about the present configuration. In short, however willing to allow for great upheavals and depressions in quasi-modern times, the author does not see how the coexistence of the remains of whales and marine-shells with living specimens of trees on the *same lands* can be satisfactorily accounted for, except by a former action of drift, similar to that which covered Northern Europe and North America with erratics and *débris* —the polar examples differing only from those of other countries by the preservation of wood in its pristine condition through the excessive cold of the Arctic region.

ON THE DISCOVERY OF THE ICHTHYOSAURUS WITHIN THE ARCTIC CIRCLE.

Among several interesting fossils brought home by the recent Arctic expedition, under Sir Edward Belcher, were some fossil remains of the Ichthyosaurus. The position where the remains were found is on the summit of Exmouth Island, about 700 feet above the level of the sea. The upper stratum is limestone, containing numerous fossils, and is about thirty feet in thickness. The inferior stratum is entirely of red sandstone, of a deep red color, which gave to the island, in the first instance, the name of Red Island.

CONNECTION OF FOSSIL FOOT-PRINTS WITH THE THEORY OF PROGRESSIVE DEVELOPMENT.

At a recent meeting of the Boston Society of Natural History, Professor H. D. Rogers exhibited a number of fossil impressions occurring in the red shale, or carboniferous red sandstone, next underlying the anthracite coal measures of Pennsylvania. A portion of them are identical with specimens found some years ago, by Isaac Lea, Esq., of Philadelphia, in the same geological horizon, and by him attributed to Reptilians; others are from a horizon 1,300 feet lower. These specimens also present a series of impressions, not observed by Mr. Lea in his specimens, consisting of the right and left feet, and apparently the fore and hind feet of a small species. Professor Rogers had not yet formed definite conclusions as to their nature, but they are obviously Reptilian. They occur invariably upon surfaces which appear to have been slimy and exposed to the air: some show the spots which are attributed to rain-drops; others, trickling water marks and wave marks. The slimy surface is attributed by Professor Rogers to the finest clayey deposit from the ocean, at different intervals, giving the rock the tendency to scale off in thin layers. The thickness of the carboniferous red sandstone is estimated by Professor Rogers at 3,000 feet; some of these specimens came from a depth of 2,000 feet in that formation, and appear to be the oldest vestiges of reptilian creatures yet found in the palæozoic rocks of America. The position of the footprints discovered by Mr. Lea is 1,000 or 1,500 feet above the base of the conglomerate, or first member of the coal measures, while these described by Professor Rogers extend, as has just been stated, some 2,000 feet below that geological horizon.

Longitudinal markings, looking like trails, probably of mollusca, are often found in these rocks, and were exhibited by Professor Rogers. The most common of these impressions is about half an inch in breadth, and consists of three separate lines of corrugations, the central band having the corrugations exceedingly minute. Toward one margin of the trail there is invariably a narrow, sharp groove, two or three inches in length, which runs out by a gentle curve toward the edge of the trail, and another commencing within the margin, and terminating likewise by a slight inflection in advance of the first.

These it was suggested as possible, may have originated from the edge or lip of the shell of the crawling mollusk, grooving the softened mud.

After describing, in a general way, the reptilian footprints in the carboniferous red sandstone of Pennsylvania, assigning the positions which they occupy in the formation, Professor Rogers proceeded to offer some reflections, showing the bearings of our present knowledge of the footmarks in the ancient strata generally, on certain cardinal doctrines of geology, especially on the theory of a progressive development in the extinct inhabitants of the earth. He called attention to the fact that, associated with the earlier bird tracts, there are none ascribable to quadrupeds, or any mammalian creatures, while in company with those of the earlier reptiles, occur none attributable to birds. The first birds seem to have appeared about the close of the Triassic or dawn of the great Oolitic period of the middle secondary ages, and no mammalian animals have left either their prints or their skeletons in strata of a date so old; while of neither bird nor mammal is there print or vestige of any kind in the still more ancient deposits of the carboniferous and yet earlier rocks, in which the tracks and bones of reptiles and fishes, and the trails and shells of mollusks are of frequent occurrence. Such successive disappearance of the traces of the higher forms of life with the advance of geological time, is one of the clearest proofs we can have of a progressive elevation in the scale of structure of the races successively created. The law of successive appearance of the footprints, is quite as conclusive as that of the parallel introduction of the actual skeletons and remains of the creatures themselves; it is perhaps of even more weight, as precluding all discussion upon the differences in degree of destructibility of the bones or carcasses of the several classes of animals which peopled the ancient world. Some of the bird-tracks and reptilian footprints left on the once soft surfaces of the old rocks, are as clear and legible imprints as any impressed yesterday on surfaces of moist mud or sand, by the creatures of corresponding structure. Once buried and sealed up, their preservation has been independent of the lapse of time. This law of a progressive rise in the character of the footprints, like that so generally recognized in regard to the organic remains themselves, distinctly refutes the view urged by Sir Charles Lyell, and some other disciples of the Huttonian theory of the earth's history. Fancying a uniformity in the series of past changes in the animate and inanimate world, they contend that the evidence in support of the theory of progressive development of organic life is inconclusive, on the ground that the higher forms being inhabitants of the land, we ought not to look for their remains in strata of marine or aqueous origin, but must suppose they were never entombed. But the negative evidence from footprints is of positive force when it appeals to appearances in the imprinted surfaces of the rocks which show that they were exposed in a moist state to the air, above the level of the waters, and in situations as accessible to mammalia as to birds, and in the case of the still earlier formations, as accessible to both mammalia and birds as to the reptiles, which left their tracks in such numbers upon them.

Professor Rogers also adverted to the superior value of the evidence afforded by such unequivocal shore marks as those of the footprints, and the

markings which usually accompany them, over that of the "ripple markings," so generally appealed to by geologists as the signs of the ancient water levels or sea-margins of the globe. Explaining, in accordance with the suggestions of Babbage, how these latter may be produced under *deep water*, by the elastic undulation of the fluid molding the movable sediments into wave-like grooves and ridges, having the semblance of the ripple transmitted to the bottom of shallow waters by the wind, he showed how easily this appearance in the strata may lead geologists to erroneous inferences as to prolonged subsidences of the earth's crust where the phenomenon abounds. The footprints of birds and reptiles on the rocks give evidence which is less fallacious, for they indicate, without any ambiguity, that they were impressed in marine or tidal strata, while these were yet moist, and were intermittingly exposed, wet, to the air, and covered up. They are, therefore, among our best records of the ancient water levels of the continents.

NEW FOSSILS FROM THE SANDSTONES OF THE CONNECTICUT VALLEY.

The position of the sandstones of the Connecticut valley is of much interest to the geologist, and has never been positively determined. This is mainly owing to the fact that with the exception of the footmarks, very few well-characterized fossils have been discovered in this formation.

Mr. Edward Hitchcock, Jr., in a communication to "Silliman's Journal" describes a fossil fern found in the sandstone of Mount Tom, near Easthampton, Mass., which seems without doubt to belong to the genus *Clathropteris* of Brongniart. Previous to this discovery several specimens of this genus had been found, and are now in the cabinet of Amherst College, but none so well defined as to indicate the genus to which they now seem undoubtedly to belong. Brongniart regarded this fern as very characteristic of the Lias sandstone.

The specimen in question was found in a coarse reddish sandstone, in the west face of Mount Tom. The upper part of this mountain is trap, beneath which the sandstone crops out with an easterly dip of about 25°. The sandstone has a south-easterly dip accross the whole of the Connecticut valley. That east of this trap range is made up of finer materials and is of a more slaty character than that on the west. The place where this fern occurs is somewhat west of the middle of the valley. President Hitchcock has lately found by measurement that the thickness of the sandstone east of Mount Tom is more than 8000 feet, and that on the west, or below Mount Tom, is nearly 5000 feet. Supposing one half of this thickness to be accounted for by original deposition on an inclined surface, there will still remain a thickness of some thousands of feet both above and below the locality of the fern. A thickness equally great, for the sandstone of the Connecticut valley was found in measuring another section, across the valley at Turner's Falls, thirty miles north of Easthampton. It appears therefore to be certain that a species of Clathropteris occurs in the sandstone of the Connecticut valley not far from its center, measuring across the strata, and near to the interstratified

beds of trap, both above and below. Now since this fern is found in Europe only in the upper part of the Trias and the lower part of the Lias, it is very probable that it occupies the same geological position here. If so, we ascertain the existence of a zone of rock in the Connecticut valley not far from the junction of the Lias and Trias. And since two measurements of sections across this valley show a thickness of sandstone strata both above and below this zone thicker than the Lias and Trias of Europe, the probability seems very strong that the equivalent of both of these rocks exist here, and perhaps some others both newer and older.

At a recent meeting of the Boston Society of Natural History, Professor Jeffries Wyman exhibited some fossil bones from the sandstone of the Connecticut valley. They had been examined twenty-five years ago, and were recognized as bones by Mr. Ellsworth. Fifteen or sixteen specimens had been recently sent him for examination, but they were mostly in very small fragments. Only one or two give any clew to the nature of the animals to which they belonged: but one, which he exhibited, he had found to be a vertebra, with portions of other vertebræ in front of and behind it. This vertebra presented two important features, viz., transverse process and an inferior spinous process. This proved the bone to have belonged to a higher class of animals than fishes. A concave extremity and other markings make it pretty evidently correspond to the vertabra of a reptile, possibly to an anterior caudal vertebra of a Saurian. In one or two specimens, a transverse section presented a large cavity surrounded by a thin wall—rather resembling the bone of a bird than that of any other animal. The greatest improbability connected with the subject is, that the remains of birds and reptiles should be found mingled together in the same formation. They are certainly not mammal, but Dr. Wyman has not much hesitancy in pronouncing some of them reptilian.

During the latter part of the year 1855, in some excavations made at Springfield, Mass., on the east side of the Connecticut river, in the red sandstone, portions of the skeleton of a vertebrate animal were discovered. The bones were the most entire of any hitherto met with in the sandstone rocks of this valley. Their character has not, however, as yet been determined. Accompanying these bones were numerous plant impressions, evidently fucoidal in their nature.

ON THE CHARACTER OF SOME LIGNITES.

At a late meeting of the Boston Society of Natural History, Professor Rogers exhibited two specimens of lignite, one from the middle secondary rocks of Lancaster county, Pennsylvania, and the other from the coal-bearing rocks of Eastern Virginia.

These specimens are interesting, not only as examples of the beautiful preservation of woody structure in lignite, but as affording additional evidence of the close relationship between the groups of strata in which they are respectively found. Both specimens are jet black, and, when broken transversely to the fiber of the wood, present the smooth, conchoidal fracture, and the luster of anthracite coal. The longitudinal surfaces exhibit the structure

of the woody stem as perfectly as the finer varieties of silicified wood, and what is chiefly important, the details of structure are the same in both specimens. The most prominent characters under the microscope, are—

1. The mass consists of elongated cells, with areolar markings, and includes few or no proper ducts. 2. These cells are intersected by thin, medullary plates, composed of short cells, with similar, but more scattered markings. 3. The areolæ of the elongated cells are arranged in a single, very rarely a double row, on each side of the two faces which are parallel to the medullary plates, but are entirely absent from the other faces of the cells. In all these particulars, as well as in the dimensions of the cells, and the size and form of the areolæ, Professor Rogers considered the structure of these lignites as closely agreeing with that of the fossil coniferous wood described and figured by Witham, under the name of *Peuce Huttonia* and *P. Lindleiana.* This fossil genus, almost identical in woody structure with the modern pine, was found by Witham to be restricted to rocks of the Oolitic period. Hence the characters of these lignites, while they furnished a new evidence in favor of the view which Professor Rogers has heretofore maintained of the near affinity in time of the so-called new red sandstone, or Triassic rocks of this country, and the coal-bearing deposits of eastern Virginia and North Carolina, helped to confirm his conclusion that both these belts belong to a period corresponding to the lower part of the Oolitc or Jurassic series of Europe. Professor Rogers added that these lignites appear to be identical in structure with that variety of silicified wood found in the coal-bearing rocks of eastern Virginia, to which he had formerly referred when speaking of the Jurassic age of these deposits.

ON THE FORMATION OF FOSSIL RAIN-DROPS.

At a recent meeting of the Boston Society of Natural History, Professor Jeffries Wyman exhibited some of the results on experiments on the formation of rain impressions in clay; from which it appears that ordinary rain marks are characterized by the existence of radiating lines around the circumference of the impressions, which are caused by the fragments of the drops as they are dispersed often impinging upon the plastic surface. If a mass of water is thrown into the air and allowed to fall on soft clay, the form of the impression will depend upon the condition of the drops at the time of contact. In descending, the drops assume the following forms, viz.: first, that of the flattened sphere; second, that of a cup with the concavity downward; third, that of a ring; and fourth, those of two or more spheres formed by the rupture of the ring. If the sphere be above a certain size, the impression presents a reticulated appearance in the center, with radiating lines around the circumference. The impression formed by the cup is reticulated in the center without radiating lines. The ring forms an impression corresponding with its shape, with radiating lines on its inner border, and sometimes on its center border. Professor Wyman thought that rain marks could be distinguished from those of spray. The rain mark is modified by the condition of the surface on which it strikes; if the latter is hard, or of a coarse material,

the minuter details are not shown. On examining the fossil rain marks he had not found that the radiating lines were preserved. They were doubtless destroyed by the drifting in of the new material by which they were covered up. In other respects they resembled recent rain marks, and could be accounted for in no other way than by the contact of drops of falling water.

At a subsequent meeting Professor W. B. Rogers presented the results of calculations which he had lately made, of the terminal velocity of rain drops of different diameters. As the impinging force of the drop must in all cases depend on its weight and velocity jointly, the determination of the latter quantity, even approximately, would seem to be of considerable interest in connection with the subject of rain-drop impressions. Were the space around the earth a vacuum, a falling body would continue to be accelerated at a nearly equal rate to the end of its descent, and would not attain its maximum velocity until the moment of its impact on the ground. Such, however, is not the condition of a body descending through the atmosphere. The particles of air lying in its way oppose a resistance to its motion, and this force increases in a very rapid ratio as the velocity augments. There will, therefore, in every case, be a certain speed at which this resistance, acting upward, will precisely equal the weight of the falling mass, and when this is once attained all further acceleration must cease. In these conditions, supposing the air to be of uniform density down to the earth, the body will fall through the remaining distance at a uniform rate. This terminal velocity, therefore, is obviously the greatest speed which, under the conditions, the body can acquire by descending through the air, however great the altitude from which it may be supposed to fall.

Assuming, what is probably in most cases the fact, that the rain-drops fall from a sufficient height to attain a terminal velocity before the close of their descent, and taking as the basis of the calculation the formula of Hutton, which expresses numerically the law of resistance as determined by experiment in the case of spherical bodies, Professor Rogers, in the first place, computed the terminal velocity of a drop of water one tenth of an inch in diameter. Thence he deduced the velocities corresponding to other successively smaller diameters, by the simple rule that for unequal spheres of like material, the terminal velocities are proportional to the square roots of the diameters. In this way was calculated the following table of the terminal or greatest attainable speed of spherical rain-drops ranging in diameter from one tenth to one fourthousandth of an inch.

Diameter.		Ter. Veloc. per second.	
1-10	inch	71·5	feet.
1-20	"	50·5	"
1-30	"	41·4	"
1-40	"	35·6	"
1-50	"	32·08	"
1-100	"	22·7	"
1-1000	"	7·2	"
1-2000	"	5·06	"
1-4000	"	3 50	"

These numbers would of course require to be more or less modified, if

account were taken of the altered form of the drops as they descend, but as we are ignorant of the nature and amount of this change we can not determine its effect on the terminal velocity.

If, instead of assuming the descending globule to consist of water throughout its whole volume, we suppose it to be a hollow shell of water like a microscopic soap-bubble, it is obvious that for the same diameter the terminal velocity would be greatly less than in the above table. Admitting with Saussure and others that clouds are made up of such hollow vesicles of extreme minuteness, it can be shown that their descent to the earth would be so slow as to make their gravitating tendency inappreciable during the short time in which we watch them as they float by.

ON THE EPOCH OF THE MAMMOTHS; ELEPHAS PRIMIGENIUS.

At a recent meeting of the Boston Society of Natural History, Professor H. D. Rogers called attention to the interesting palæontological fact that while the remains of the fossil elephant or Siberian mammoth of the Eastern Continent are imbedded *in* the great drift stratum, those of the fossil elephant of America are as invariably *above* it, lying in superficial deposits of a distinctly later age. It is now generally conceded that the relics of the *Mastodon giganteus* of North America, which do not extend beyond this continent, are nowhere involved in the general or earlier drift, but lie upon it, inclosed either in more recent swampy deposits, or in the nearly as recent later local diluvial clays and gravels of the great lake and river valleys of the country. But the fact that the bones and teeth of the extinct elephant on this continent are entombed in the same superficial materials seems not to have been sufficiently adverted to by geologists, or, if passingly stated, its bearings have been overlooked.

That the American elephant was the cotemporary of the *Mastodon giganteus* is not only proved by the occurrence of great numbers of their teeth and bones side by side in the great marshy alluvium of Big Bone Lick, but is manifest on a scrutiny of the conditions under which its remains are alleged to be imbedded. A careful review of all the cases on record of the positions of the elephant remains must satisfy geologists, familiar with the more recent strata of this country, that these two colossal animals lived together in the long period of surface tranquillity which succeeded the strewing of the general drift (the period of the Laurentian clays), and were overtaken and exterminated together by the same changes, partly of climate, partly of a second but more local displacement of the waters—that namely which reshifted the drift, and formed our later lake and river terraces. The fact that these extinct animals thus occur only *above* the true drift in North America, and *in* it in Siberia and Europe, would seem to indicate one of two things: either that the drifts of the two continents are not of the same epoch, or these being of one age, that the fossil elephants of the two regions are not of one and the same species. If we admit, with the great body of geologists, that the general drift-covering of all the northern latitudes of both continents is of one origin and one date, we are constrained to regard the mammoth of these respective

lands as different. Yet the identity of date of the two drift formations should not be dogmatically pronounced upon in the present incomplete condition of comparative geology.

INTERESTING FOSSILS.

At the last meeting of the American Association, President Hitchcock, exhibited the jaw of a fossil fish which he had received from the coal-fields of Illinois. The specimen was about a foot long, curved like a saber, and on its edge were set, in sockets, seven teeth with serrated edges. It was found about three inches above a bed of coal three or four feet in thickness, making it certain that it was in the coal measures. Professor Agassiz said that this was one of the most interesting specimens he had ever seen. The idea of a shark was at once suggested, and yet it could not be a shark for this reason, that although the shark had teeth in seven rows yet they were not set in a socket, and they were behind each other, not by their edges but by their flat surfaces. Moreover, no shark had teeth in his upper jaw, if we understood by that term what was understood in higher animals. The bones of the upper jaw were in charts reduced to cartilages at the sides of the mouth, and the palatine bones which in higher animals formed the roof of the mouth were in sharks set with teeth. Sharks' upper teeth were, therefore, palatine teeth and not jaw teeth. But in some sharks, as in skates, we had the beaks uniformly pointed. In the saw-fish the beak projected with a double row of teeth at the sides in sockets, and this was the only type in which any thing similar to the fossil could be observed. Furthermore this bone when subjected to the microscope was found to be made up of the same hexagonal tissue, to have the same tesselated structure as the cartilage of sharks and skates and the saw of the saw-fish. He concluded, therefore, that this was a projection from one side of the shark's head, and its point met a corresponding projection from the other side, both forming a semicircle in front of his head.

Professor Agassiz also stated that the general result of his comparison of the fossil fishes of the American coal measures was, that there were two very different kinds of fishes, one represented by the very metamorphic fragments now on the table, and identical in its character with that which Dr. Newberry had found in Ohio, the other in southern Illinois, whence Dr. Cassidy had sent him a number of fossils, among which were ten or twelve species of fish, as many as were generally found in a water basin after fishing for one season. The fish found here were identical in their character with those of Bristol in England. The two were as different as the fish fauna of the Baltic and Mediterranean, or the Mediterranean and the Red Sea.

President Hitchcock also exhibited a series of footmarks of an animal which, from analogy, he had called a Batrachian. It was web-footed, and the web extended beyond the toe. It was a two-legged frog, with feet twice as large as an elephant's. They had in Europe the Labyrinthodon, which was as large as an ox, but he was a mere pigmy compared with this. What he had formerly considered a nail he was now convinced was but a protuberance.

Professor Hall remarked in this connection that he was convinced that

about three fourths of the Missouri and Illinois coal-fields marked out by Owen would have to be wiped off the map, and its place supplied by Silurian strata with its Pentamerus, Oblongus, and other characteristic fossils. He had seen Lower Silurian and Upper Silurian fossils over large areas of Owen's coal-fields. He supposed most of that coal to be outlayers resting in basins, and having no connection with each other.

New Species of Dinornis.—At a recent meeting of the London Zoological Society, Professor Owen communicated a memoir on a new species of Dinornis, remains of which have, from time to time, been received from New Zealand. The name proposed is *Dinornis gracilis* (Slender-legged Dinornis), as the chief peculiarity of this remarkable species is that it manifested the proportions of a wading-bird, on the scale of the ostrich. This singular bird must have stalked about New Zealand, and probably waded the streams, or along the shores and estuaries of the island, like a gigantic stork or crane. Professor Owen had received indications of such a species ten years ago; but had delayed announcing it, until evidence satisfactory to other naturalists had arrived. It forms the thirteenth well-established species of extinct wingless birds that have been restored from the evidence of fossil remains discovered in the island of New Zealand.

Impressions of Insects in the Triassic Rocks.—At a recent meeting of the Boston Society of Natural History, the President, Dr. Warren, remarked that some time since he had stated that, though a matter of great doubt, he thought it probable that, at some time, the *impressions of insects and their tracks* would be found in solid rock. Since making that observation, he had received several small slabs, upon which are tracks apparently, if not really made by insects, which resemble the tracks of the cricket, cockroach, or beetle. Upon several specimens, these tracks are of the same width and general appearance; and the individual footprints, if they may be so considered, are alike in all the specimens. These specimens were from the banks of the Connecticut. One of the slabs likewise presented an impression very much like that of a spider's body and extremities.

New Gigantic Fossil Bird.—At a recent meeting of the French Academy, M. Prevost submitted the fossil bone of a bird found in the Paris basin, near Meudon. It was a *tibia* or leg bone; its length $17\frac{3}{4}$ inches, its breadth, at the lower end, fully 3 inches; at the upper, $3\frac{3}{4}$; at the middle $1\frac{3}{4}$. A difference of opinion existed among the naturalists as to whether it belonged to an Echassier (a long-legged bird) or a Palmipede. If the former, M. Prevost thought that it must have had twenty times the bulk of the swan. M. Valenciennes regarded it as more allied in form to the albatross, and in this case its dimensions will not be so great as M. Prevost conjectured. It has been named Palæornis Parisiensis, and was found at the bottom of the tertiary beds, resting on the chalk. It was, therefore, much older than the huge birds of New Zealand and Madagascar, which are found in alluvial deposits.

New Fossil Reptile.—At a recent meeting of the London Geological Society, Professor Owen described a new species of extinct bidental reptile (*Dicynodon tigriceps*), transmitted from South Africa. The skull surpasses in size that of the largest walrus, and resembles that of the lion or tiger in the great development of

the occipital and parietal ridges, the strength of the zygomatic arches, and the expanse of the temporal fossæ—all indicating the possession of temporal (biting) muscles as largely developed as in the most powerful and ferocious of the carnivorous mammalia. This unique modification of a sauroid skull is associated with the presence of a pair of long, curved, sharp-pointed, canine tusks, descending as in the machairodus and walrus, outside the lower jaw when the mouth is shut, these tusks being developed to the same degree as in the smaller species of Dicynodon (*D. lacerticeps*, *D. testudiceps*, etc.), described by the author in a former memoir; and, as in those species, so in the present more gigantic one, no other trace of teeth was discernible, the lower jaw being edentulous, as in the extinct Rhynchosaurus, and the Chelonian reptiles. Most of the extinct reptiles exemplify the law of the prevalence of a more general structure, as compared with the more specialized structures of existing species. The Labyrinthodonts combined sauroid with Batrachian characters; Rhynchosaurus, saurid with Chelonian characters. The Ichthyosaurus had modifications borrowed from the class of fishes, and the Pterodactyle others borrowed from the type of birds and bats—in both cases engrafted on an essentially sauroid basis. The Dicynodonts—which were like lizards in their more important cranial character, as for example, the divided nostrils, the dependent tympanic bone, and the pair of symmetrical suboccipital processes—resembled the crocodiles in the extent of ossification of the occiput, resembled the Tryonyces in the extent of ossification of the palate, and in the form and position of the posterior nostril; and resembled the Chelonia generally in the edentulous trenchant border of the whole of the alveolar part of the lower jaw, and of a great part of that of the upper jaw. But they also superadded to this composite reptilian structure of the skull a pair of long, sharp, descending tusks, and temporal fossæ and ridges, which seem to have been borrowed from the mammalia class.

NEW MINERAL OÖGUANOLITE.

At a recent meeting of the Boston Society of Natural History, Dr. A. A. Hayes presented a specimen of a fossilized egg from the Guano Islands, off the coast of Peru, which in its interior contained a new mineral compound.

The form of the original mass was ovoid, the circular outline having been reduced by compression, about one third. Externally rough, from adhesions, there were smooth parts, from which a thin layer could be removed, which when cleaned, had the organized structure of egg shell, although partly changed in chemical composition. In the examination of one half of the specimen, fragments of shell were found, crushed into the mineral occupying the cavity. The color of the mass was Nankin-yellow externally, deep yellow and reddish brown within. The compact parts scratched calcareous spar, its general hardness fully equaling that of this mineral. The fracture of the mass exhibited a crystalline structure, most remarkable near the center, where the yolk may have decomposed. The crystals, in no case distinct, presented an aggregate of flat, plumose prisms, radiating from centers; these have a marked pearly, or satin-like luster, and readily divide along natural joints.

The odor of the mineral is the same as that of guano, while its taste is saline, leaving a pungent impression. Soluble in water, excepting some sand, lime soap, and remains of shell; the solution is light yellow in color, and gives, by appropriate tests, the reactions of sulphuric acid, ammonia, and potash, being slightly acid. The chemical analysis of the most pure parts of the crystalline portion, demonstrated the interesting fact that this mineral is a double sulphate of ammonia and potash, a compound hitherto unknown as occurring naturally.

100 parts afforded:—

Moisture	1·00
Sulphate of Potash	51·66
" " Ammonia	38·25
" " Lime	1·17
Phosphate of Magnesia	1·08
Soap of Lime and Carbonate of Lime	2·20
Ferruginous Sand	4·30
	99.66

The atomic proportion of sulphate of ammonia for 51.66 sulphate of potash, is 40.84, and when we dissolve this mineral in water, and allow the impurities to subside, the clear fluid affords crystals in groups, which have this composition. Other parts of the mass contain more sulphate of potash, even so much as 70 per cent., being obviously a mixture. The luster, and perhaps the plumose form of these crystals, is due to the presence of the other compounds at the moment of their formation. It was found that pure crystals, dissolved in water containing guano, presented the same peculiarity as they assumed the solid form. There are, in this connection, some points which need further elucidation, and for this purpose a portion of the specimen has been retained. The occurrence of salts of potash, instead of soda salts, in the guano of the rainless climates, has been alluded to by chemists, but I have nowhere met with the fact stated, that these guanos, however ammoniacal, and, in consequence, *apparently* alkaline, are truly always acid in their reactions. Regarding this mineral as affording a beautiful illustration of the withdrawal of a definite compound of soluble salts, from a putrefying mass, through which they were distributed unequally, it becomes connected with the more permanent and perfect forms having earthy constituents. In any system of mineralogy, it will take a place with potash salts, as a double sulphate of potash and ammonia bases.

In accordance with the practice of naming such minerals with reference to their origin, I have adopted the name *Oöguanolite* for this body.

METEORIC IRON FROM GREENLAND.

Forchammer describes a meteoric stone discovered by Rinck, in possession of the Esquimaux at Niakoruak, lat. 69° 25′, by whom it had been found at a short distance from their hut, on a stony flat through which the river Annorritok flows into the sea. It weighed 21 pounds. The specific gravity of the whole mass 7·00, that of small fragments varied from 7·02 to 7·07. It was

so hard that it could neither be filed nor sawed, but was very brittle. Its fracture was granular; it took a high polish, and showed beautiful Widmannstätt's figures when acted upon by nitric acid. By treatment with acids it evolves sulphureted hydrogen, and hydrogen of bad odor exactly like inferior cast iron. At first iron alone is dissolved, and a black matter consisting of minute crystals is left behind, which eventually dissolves, and a black powder, which proved to be carbon, floats through the fluid, while, in place of the fragment of the iron, a gray porous mass amounting to 1 or 2 per cent. of the stone is left. It contained iron, 93·39; nickel, 1·56; cobalt, 0·25; copper, 0·45; sulphur, 0·67; phosphorus, 0·18; carbon, 1·69; silicon, 0·38; total, 98·57.

Besides these there are found metals of the alumina group (with oxyds soluble in caustic alkalies), of the Zinconia group (with oxyds insoluble in alkalies, but precipitated from their salts by sulphate of potash), and of the Yttria group (oxyds insoluble in alkalies, soluble in carbonate of ammonia, and not precipitated by sulphate of potash). The two latter groups, which have not been previously found in meteorites, form the principal part of the undissolved gray porous mass, but their quantity is so small that the author has been unable to determine with certainty what members of these groups are present. The crystalline grains, which are less soluble than the rest of the mass, consist of iron and carbon, with small quantities of sulphur and phosphorus. Although it is difficult, if not impossible, to stop the solution at the proper point, so as to insure this substance being pure, Forchammer has made two analysis, and found 11·06 and 7·23 per cent. of carbon. A carbonate of iron having the formula Fe_2 C, would contain 9·66 per cent. of carbon, and this is probably its constitution. Its specific gravity is 7·172. This meteoric iron belongs to a very rare variety, and contains so large a quantity of carbon that it may be called meteoric cast iron. That found in Greenland by Parry, as well as another specimen mentioned by Forchammer were perfectly malleable. *Poggendorff's Annalen*, vol. 93, p. 155.

NEW METEORITES.

Dr. J. Lawrence Smith, in a communication to *Silliman's Journal*, describes several meteorites not before examined:

The first is a meteorite from Tazewell County, Tennessee, of the weight of 55 pounds. It was not seen to fall, but was found in plowing. A section of it, when heated with nitric acid, displayed the Widmannstättean figures most beautifully. Its composition was iron 83·02, nickel 14·62, with small proportions of copper, cobalt, phosphorus, chlorine, silica, sulphur, and magnesia. An examination of the mass led to the discovery of small particles of *Schreibersite* disseminated through it. This mineral is a *phosphuret* of iron and nickel, and is one of the most interesting substances associated with meteoric bodies. It resembles very closely magnetic iron pyrites, and Dr. Smith expresses an opinion that much of the so-called magnetic pyrites, associated with meteoric iron, will not, upon examination, be found to contain a trace of sulphur. In several meteorites examined by him this has proved

the case. Schreibersite is especially interesting from the fact that it has no representative, either in genus or species, among terrestrial minerals. Although among terrestrial minerals phosphates are found, not a single phosphuret is known to exist. So true is this, that with our present knowledge, if any one thing could prove more strongly than another the non-terrestrial origin of any natural body, it would be the presence of this or some similar body. It is commonly alluded to as a residue from the action of hydrochloric acid upon meteoric iron, when in fact it exists in plates and fragments of some size in almost all meteoric irons; and there is some reason to believe it is never absent from them in some form or other. What is meant by "some size" is that it is in pieces large enough to be seen by the naked eye, and be detached mechanically.

Dr. Smith also describes a meteorite weighing 4⅓ ounces, found in Campbell County, Tennessee; the mass of meteoric iron belonging to the Smithsonian Institution at Washington, brought from Coahuila, Mexico, and weighing 252 pounds, with two other meteorites now existing at Tucson and Chihuahua, Mexico. The Tucson meteorite weighs 600 pounds, and consists of nickeliferous iron 93·18, chrome iron 49, Schreibersite 84, olivine 5·06. The meteorite of Chihuahua is still larger, and weighs 3,853 pounds.—*Silliman's Journal.*

Examination of a Supposed Meteorite.—During the past year, at one of the meetings of the Royal Society, Sir R. I. Murchison presented a specimen found in the heart of an old willow-tree, and which was supposed to be a meteorite. When the specimen was first seen, its scoriaceous and peculiar aspect, when coupled with the evidence of persons living on the spot, showing that the tree was seriously blighted on one side in a storm which occurred about 16 years ago, had led to the suspicion that it might be a meteorite, and when nickel, cobalt, and manganese were detected in the metallic portions of the mass the suggestion was strengthened. Professor Shepard, of Amherst College, United States, who was in England, expressed his belief in the extraneous body being a true meteorite, and it was under these circumstances that Sir Roderick Murchison thought it right to have the matter thoroughly investigated. Independently of the origin of the substance, the manner in which the tree had grown round it was of deep interest to botanists. A chemical examination by Dr. Percy has, however, almost conclusively proved that the substance was simply a portion of slag; for while fragments found on the ground (one of them obviously a manufactured slag) contained nickel, cobalt, etc., as well as the mass in the tree, it is the opinion of Dr. Percy that they can all be paralleled with the known refuse of furnaces. This result will throw considerable doubt upon the origin of many so-called metallic meteorites, which, though they have not been seen to fall, have had an extra mundane origin assigned to them from their containing nickel, cobalt, etc.

COAL FROM THE ARCTIC REGIONS.

Mr. E. Merriam of Brooklyn, N. Y., publishes the following notices of coal obtained within the Arctic circle. The Hartstein Arctic Expedition visited

Haroe Island, latitude 70° 25′ North, longitude 54° 45′ West, and obtatined bituminous coal of an excellent quality. The coal strata crops out within a few feet of the shore in the side of a hill, and is from four to five feet thick, and a few feet above the sea level. The samples furnished me by the officers contain small pieces of crystallized naptha, of a color as bright as the finest specimens of gum arabic. I find that on exposing this coal to the action of our atmosphere it loses weight rapidly, and I have, therefore, been obliged to keep it in air-tight vessels.

They have also furnished me with the English analysis, as follows:—

Specific gravity	1,3848
Volatile matter	50·6
Coke, common	9·84
Fixed Carbon	39·56

The natives burn this coal in stoves, and prefer it to the English. The Island of Disco contains abundance of this coal. Captain Hartstein mined the coal on Haroe Island and it was brought on board the vessel in tubs. Captain Inglefield visited these mines and obtained seventy tons of coal, and remarked that a thousand tons could be obtained in a few hours. Captain McClure found coal (bituminous) in latitude 75° North, longitude about 120° to 122° West. Captain Parry, in 1819, found pieces of bituminous coal on Melville Island in latitude 75°, longitude 111°; and the captain of a whaler who entered Behring's Straits with Captain Colinson, informs me that anthracite and bituminous coal is found on the shores of the western coast of the Polar seas.

Coal in China.—Some recent investigations into the character of the anthracite coal deposits of Fuhkeen, China, have been made by Dr. Macgowan. The mineral is sometimes found equal to the best American variety, and can be landed at the port of Amoy at $4½ per ton. At present only a small quantity is produced, chiefly, however, on account of the limited demand that exists for it, as the natives only employ it in the burning of lime; the smelting furnaces of the adjacent iron mines not being furnished with a sufficiently powerful blast to allow of anthracite being used in them. Fossils obtained from the "underclay" appeared to be identical with similar remains of *Stigmaria* from corresponding strata of the carboniferous series of England and the United States.

VERD-ANTIQUE MARBLE.

Within a recent period extensive quarries of the beautiful mottled green marble, or aggregation of marble and serpentine, known as *Verd-antique*, have been discovered, and are now extensively worked, at Roxbury, Vt. The quarries of this stone in the old world, which were drawn upon to furnish decorating materials for some of the finest works of ancient architecture, have almost entirely disappeared. The location of the modern Verd-antique is on the summit of the Green Mountain Range, in Roxbury, Vt., in a narrow valley made by branches of the White River and the Dog River, the former

running southerly into the White River and the Connecticut, and the latter into the Winooski and Lake Champlain. The quarries lie on the westerly side of this valley, where full of richness and beauty as they are, they have been lying dormant, but in full view of settlers, and even explorers, for years. The marble so far as it has been discovered, lies in a line running nearly north and south, a distance of about half a mile immediately contiguous to the Vermont Central Railroad—the rails passing, indeed, at the very foot of the quarries. The quarries located and now owned by the American Verd-antique Company, consist of six or eight out-crops, a few rods distant from each other, and ranging in height above the railroad from twenty to one hundred feet. One of these quarries has been opened and worked to considerable extent—sufficient to test the quality of the material and to indicate an exhaustless supply. The marble is found to improve rather than otherwise, as the quarrying proceeds, in texture and beauty, and in all the qualities which render it so superior to other marbles, especially in strength. It is ascertained also, to a practical certainty, that blocks of any desirable dimensions can be got out and wrought with facility into all the various forms which utility and ornament may suggest. Hitherto whenever any thing like the Verd-antique has been discovered among our rocks, it has been in small fragmentary quantities, and never in a condition to be available for any useful or ornamental purpose. So universal has been the experience in this respect, that every scientific man, on first hearing of the discovery at Roxbury, has at once declared his firm conviction that the Verd-antique could not be found there in any useful quantity. The doubt has, however, been dispelled by the production of perfect and entire blocks 20 feet in length, 8 in breadth, and 3 or 4 in thickness. The green color, varying from the deepest to the lightest hue, pervades; and the seams or veins are of the purest white and scattered throughout the material in every direction, with a variegation of gracefulness which no art could produce. The Verd-antique Company have contracted with the Government to furnish a considerable quantity of this magnificent material for ornamental portions of the new Capitol at Washington. They are now engaged in fulfilling this contract, and among the pieces to be furnished are several columns about a foot in diameter and ten feet in length.

Dr. Hayes, who has carefully examined this marble, pronounces the basis to be an indefinite mixture of serpentine and greenish-white talc; with a silicate of alumina and protoxyds of iron and manganese, which serves to render it compact and probably imparts much of the green color. Some specimens also contain actinolite, with talc firmly united so as to present a close texture and considerable resistance to fracture. The portion of chrome iron ore in crystalline grains, varies in different specimens; but it is never large enough to seriously interfere with the operations of sawing and polishing. The white portions of the marble, Dr. Hayes has ascertained to be an anhydrous carbonate of magnesia, nearly pure.

ON THE ARTIFICIAL FORMATION OF MINERALS.

There are a number of minerals with regard to which most mineralogists, geologists, and chemists are of opinion that they can only be formed by crystallization from a melted mass. A considerable portion of these minerals are, however, infusible, or, at least, require such a temperature for fusion as can not reasonably be supposed to have been concerned in the formation of the rocks in which they occur. Some of those compounds, on the other hand, may be easily formed by fusion at a moderate temperature. Thus, more than thirty years since, Mitscherlich showed that augite or pyroxene—one of the most widely distributed minerals—may be formed by melting together silica and various bases of the magnesian series, in such proportions that the oxygen of the acid amounts to twice as much as that of the bases. He also showed that this mineral substance, with its proper form, occurs in the slags obtained in metallurgical operations, and the subsequent examination of slags has led to the recognition in them of several other compounds identical with, or analogous to native minerals. Nevertheless, there are a great number of minerals in whose origin, it is very probable, intense heat has exercised an essential influence, which have never been produced artificially, nor observed in the products of metallurgical operations. The very happy, and in some respects fertile idea of Ebelmen, to expose substances to the joint influence of heat and a solvent capable of being volatilized, and thus obtain them crystallized, has furnished some very valuable results; but although boracic acid—the solvent used—has been found in many native minerals, in which its presence had not been suspected, still its occurrence is too rare to admit of the opinion that it has played any very considerable part in the production of the more widely distributed minerals constituting the earth's surface.

Forchammer has recently made experiments of the same character as those of Ebelmen, but with substances as solvents which are less rare than boracic acid—chlorid of sodium, calcium, mangnesium, etc.

The production of apatite was the object of the first experiments, and he was led to them by the results of his analysis of sea-water, and his observations of the constant presence in it of phosphate of lime, together with a still smaller amount of fluorid of calcium.

After failing in every attempt to produce apatite in the wet way, and guided by the circumstance that apatite occurs chiefly in lava and metamorphic rocks, under conditions which appear to indicate an igneous origin, he came to the conclusion that if this was the case, chlorid of sodium might have been concerned in its formation.

By melting phosphate of lime with chlorid of sodium, and allowing the mixture to cool very slowly, a mass was obtained which presented a great number of cavities containing an abundance of long columnar crystals. The residue left, after treating this mass with water and then with acetic acid, corresponded with the composition of apatite. The density of this artificial apatite was found to be 3·069, and the hardness so great that a slab of fluor spar became dull when rubbed with the powder. The occurrence of apatite

in the magnetite bed of Scandinavia, and the composition of the bog iron-ore of the same locality, suggested the possibility that the former might have originated from bog iron-ore under the influence of chlorid of sodium at a high temperature. The bog iron-ore contains, besides oxyd of iron, phosphoric acid, lime, silica, titanic acid, and carbonaceous organic substances. The latter ingredient might correspond to the remarkable bituminous substance of the magnetite beds, and the silica, lime, and manganese might be supposed to form, with oxyd of iron, the numerous compounds of the amphibole series occurring in the magnetite beds, while apatite and titanium compounds might also be derived from the constituents of bog-iron ore.

For the purpose of ascertaining the behavior of bog-iron ore when melted with chlorid of sodium, a direct experiment was made. The cooled mass presented cavities which, when the chlorid of sodium was dissolved out, were found to contain apatite crystals. The ore itself had become black, strongly magnetic, and had acquired such a hardness as scarcely to be scratched by steel, together with a perfectly conchoidal fracture. In the larger cavities the mass was covered with small, sharply-defined crystals, which, when magnified, were found to be regular octahedrons. The ore was, therefore, actually converted into magnetite, and the phosphoric acid had separated as apatite from the oxyd of iron. In a comparative experiment with bog-iron ore alone it did not show any sign of fusion or crystallization; the color, though darkened, was still brown.

There is a great amount of evidence for the opinion that the blue tinge of some minerals, especially silicates and aluminates, is intimately connected with the presence in them of phosphate of iron, and that vivianite is the hydrate of the compound, to which the colors of cyanite, sapphirine, spinel, and correndum, as well as fluorite and apatite is owing. The author having ascertained by analysis, the presence of phosphoric acid and iron in these minerals, endeavored to obtain further evidence by synthetical experiments, and, first, to find whether the anhydrous phosphate of iron had the same color as the hydrate. This was found, under certain conditions, to be the case, and the whole course of experimentation showed that phosphate of iron is capable of producing, in combination with alumina especially, but likewise with other substances, a series of colors, of which the intermediate phase is pure blue; on the one side the dark violet seen in some varieties of fluorite, and on the other the bluish green of the apatite. In some instances these colors may pass, by a subsequent oxydation, into yellow and red shades, like those so frequently observed in cyanite.—*Edinburg Philosophical Journal.*

MINERALS OF THE GOLD REGIONS OF CALIFORNIA.

Mr. William P. Blake, United States geologist, in a communication published in *Silliman's Journal*, makes the following observations on certain of the mineral productions of California:—

Crystalline Gold.—Good crystallizations of gold are comparatively rare in California. At Forest Hill, Placer county, an imperfect octahedral crystal of large size was found last year. The placers are only partially developed for

a short distance above and below the basal ridges, and the peculiarity of a series of similar parallel planes, lying like plates one within the other is presented. The crystal is elongated in the direction of a line parallel with the basal edges and thus becomes a regular octahedron.

The length of the longer base is one inch, and the shorter seven-eighths of an inch. I believe this to be the largest crystal ever reported; it may be called a *skeleton* crystal on a grand scale.

Arborescent and Dendritic Gold—Placer county.—Some of the most remarkable and beautiful specimens of gold ever seen, have been found at Irish creek, three miles from Coloma. They simulate the veined and reticulated appearance of leaves and more closely resemble the foliage of the Arbor Vitæ or the fronds of the most delicate ferns than of any other forms of vegetation. The filamentous and arborescent masses are frequently united to plates (as broad as the hand) which are covered with lines of crystallization and are brilliant with numberless faces of partly formed crystals. They are also combined with good crystals which are generally octahedral and have perfect faces. I have a very beautiful specimen of this character in the form of a leaf: one side is beautifully arborescent, and the other is studded with perfect octahedrons of various sizes and about twenty-five in number, including the smallest. They are geometrically arranged, all their similar edges being parallel. This is believed to be the most remarkable and beautiful specimen known. Its weight is 17 pwt. 10 grains. Length, two and one quarter inches, width, one and a half inches. One of the foliated specimens in my collection, bears a crystal having the form of a pentagonal dodecahedron with cavernous faces. One of the largest specimens of this arborescent and foliated gold that has been procured, was about twelve inches long and about four broad. A part of the specimen was a plate three or four inches long, covered with triangular marks; the remainder was arborescent, and the whole appeared to have grown from one end.

Another specimen slightly different in its character, and probably from another locality in the vicinity, was ten inches long, three broad and about half an inch thick. It weighed 31 ounces, and was free from quartz; forming a most beautiful mass of a rich yellow color and a delicately marked surface, consisting of a net-work of fibers. It appeared like a bundle of broken fern leaves closely united together. These specimens are evidently from a quartz vein, but although I have visited the locality, I have not been able to see the place from which they were taken, or to obtain any reliable information concerning their mode of occurrence and the associate minerals. Some of the foliated specimens were incrusted with a thick scale of sesquioxyd of iron.

Native Copper and Red Oxyd of Copper.—When visiting Camp Yuma at the junction of the Colorado and the Gila rivers, in December, 1853, several large masses of superior copper ore were shown to me by the officers of the fort. This ore was brought from the adjoining State of Sonora, Mexico, and the vein is reported to be near Altar. It is within the limits of the strip of territory recently acquired by purchase, and is therefore now in the United States. Specimens are frequently brought in by emigrants who cross the Col-

orado at the ferry below the fort. The ore is principally the red oxyd of copper associated with the pure metal and green crusts of carbonate. The specimens that I saw ought to yield about ninety per cent. of pure copper. This is probably the ore that has recently excited so much attention in California, and has been reported to be highly charged with gold.

Antimony—Tulare county.—A large vein of the sulphuret of antimony (antimony glance) exists in the high granitic range that borders the Tulare valley on the south. It is about eighty miles from Los Angeles and is most readily visited from the Tejon. By observations with the barometer, I found the out-crop of this vein to be at an altitude of about 6000 feet above the sea. It is on the side of a precipitous ridge of granite, and not favorably situated for examination. Its thickness was estimated to be ten feet or more. A steep chasm or channel extends from the top of the ridge to its base, and is partially filled with rocks and the debris of the vein. Solid blocks of the ore were found with this accumulation, having been broken out from the vein above; one of them was twenty-seven inches long and sixteen to eighteen wide.

The ore is associated with quartz, and where it has decomposed, an abundance of antimony ocher is found, together with crystals of selenite. Specimens of quartz traversed by long prismatic crystals of the ore were obtained.

Chromic Iron—Monterey county.—Massive chrome ore of excellent quality was shown me in San Francisco and reported to be from a short distance south of the Mission of San Juan. It is an interesting fact that it is almost identical in its appearance with the ore from "Wood's pit" in Maryland and like it, is partly covered with green coats and crusts of emerald nickel.

Salt.—Salt is found in small quantities as an incrustation or efflorescence on the soil along streams or on the margins of ponds in nearly all parts of California. It appears to be most abundant in connection with the tertiary strata and in the streams that flow from them. It is doubtless the fact that a great part of the incrustations called soda, consist principally of common salt.

Tulare county—Canada de las Uvas.—There is a small shallow lake near the central part of this pass fed by springs and streams from the adjoining valleys and ridges which are partly of tertiary strata. During the summer season the water of this lake evaporates, and its bed becomes covered with a white crust of salt which glitters in the sunlight like a field of snow.

Taheechaypah Pass.—A lake of a similar character to the one just described is found in one of the elevated valleys of the Sierra Nevada near this pass. At another locality in that vicinity and near the margin of the Great Basin, salt occurs in a thick bed, from which one hundred mule loads have been taken, and carried to the Tonjon Indian reservation for the use of the Indians.

This salt is perfectly white and amorphous, being reduced to a fine powder by simple pressure. It is sufficiently pure for table use.

BOTANY.

MOHL ON CHLOROPHYLL.

Mohl believes that the grains of chlorophyll do not belong to the ternary series of products at all, but consist of a soft proteinous substance, related to albumen, in which in most cases one or more starch-grains are imbedded, and which owes its green hue to the presence of an extremely small quantity of green coloring matter, seemingly deposited only or principally in its outer layer. By demonstrating the occurrence of chlorophyll in cells which contained no starch, or the growth of the green globules after the starch-grains have vanished, and in other cases the simultaneous increase of starch and chlorophyll grains in the same cells, Mohl has shown the groundlessness of Mulder's hypothesis, that chlorophyll is formed of starch altered by deoxydation, and that the evolution of oxygen by green foliage is merely the result of this supposed transformation of starch into green coloring matter and wax; and he maintains that, by appropriate evidence, he has abundantly demonstrated the principal mass of chlorophyll grains to consist of a substance allied to protoplasm, which certainly can not originate from a metamorphosis of the constituents of starch.

CHLOROPHYLL IN GREEN INFUSORIA.

Prince Salm Horstmar has found that the green infusoria which form so abundantly on stagnant water, when treated with alcohol, give an extract having all the properties of a solution of chlorophyll. It gives the black band in the red part of the spectrum described by Stokes, as well as dispersion of a blood-red light. The same result was obtained with an alcoholic extract of Spongia fluviatilis.—*Poggendorff's Annalem*, vol. xciii., p. 150.

THE MORA EXCELSA-TREE OF THE WEST INDIES.

Prominent among the trees which adorn the forests of Guiana, and which astonish by their profuse verdure and gigantic size, stands the majestic *Mora*, the king of the forest. Rising to the height of from 60 to 90 feet before it gives out branches, it towers over the wall-like vegetation which skirts the banks of the rivers of Guiana, forming a crown of the most splendid foliage,

overshadowing numerous minor trees and shrubs, and hung with lianas in the form of festoons. The Mora, of all other trees of the forests of Guiana, is peculiarly adapted for naval architecture; and it is to be found in such abundance that if once introduced for building material into the dockyards, there can never be any apprehension there would be a want of that timber which could not be supplied. The wood is uncommonly close-grained, and gives scarcely room for a nail when driven into it. When cleaned of sap, it is durable in any situation, whether in or out of the water. With this property it unites another of equal consideration to builders—it is strong, tough, and not liable to split, has never been known to be subject to dry-rot, and is considered, therefore, by the most competent judges, to be superior to oak and African teak, and to vie in every respect with Indian teak. The full grown tree will furnish logs from 30 to 40 or even to 50 feet in length, and from 12 to 24 inches square, taken from the main stem, while the remaining portions are suited to various purposes of naval architecture; such, for instance, as keels, keelsons, stern-posts, flins, ribs, beams, knees, breasts, backs, etc.

Thus wrote Sir Robert Schombergh fifteen years ago. (*Transactions of the Linnæan Society*, vol. xviii., p. 207) and, in the same volume, that there might be no difficulty of distinguishing the tree in the search for it in other countries, Mr. Bentham, from specimens sent by Sir Robert, publishes an excellent figure and botanical history, under the name of *Mora Excelsa;* for it had previously no place in botanical works. It belongs to the natural order of *Leguminosæ*, and to the same group or section as the well-known *Cassias.* Yet it does not appear that the attention of any of our authorities or travelers has been directed to the commercial importance of this tree till very recently. The same tree has been found to prevail in certain localities of the Island of Trinidad.—*Hooker's Journal of Botany.*

PECULIARITY OF THE REDWOOD (SEQUOIA) OF CALIFORNIA.

At the meeting of the American Association in August, Mr. W. P. Blake showed the effect produced on the wood of the *Sequoia* by alkalies. The wood has a light red color, like cedar; but when it is washed over with an alkaline solution either of potash, soda, or ammonia, or lime-water, the color changes to a deep black, and the wood looks like ebony, but with a much more distinct and beautiful grain. A decoction of the wood is also turned black by alkalies; and Mr. Blake suggests that test papers for use in chemical analysis may be prepared, which will be equal or superior to tumeric paper. When the alkaline solution is weak, the color produced on the wood is not a deep black, but has a shade of red resembling old dark mahogany or rosewood. From the ease and cheapness with which the effect may be produced on the wood, and the beauty of the panels thus treated, it will doubtless become common to stain articles of furniture made of it in preference to covering them with paint. This wood is now in constant use in California for building and carpentering, and is sold at about the price of pine.

SUBSTITUTES FOR COFFEE.

Liebig states that asparagus contains, in common with tea and coffee, a principle which he calls "taurine," and which he considers essential to the health of those who do not take strong exercise. Taking the hint from Baron Liebig, a writer in the *London Gardener's Chronicle* was led to test asparagus as a substitute for coffee. He says: "The young shoots I first prepared were not agreeable, having an alkaline taste. I then tried the ripe seeds, and these, roasted and ground, make a full flavored coffee, not easily distinguished from fine Mocha. The seeds are easily freed from the berries by drying them in a cool oven, and then rubbing them on a sieve."

There is in Berlin, Prussia, a large establishment for the manufacture of coffee from acorns and chicory, the articles being made separately from each. The chicory is mixed with an equal weight of turnips to render it sweeter. The acorn coffee, which is made from roasted and ground acorns, is sold in large quantities, and frequently with rather a medicinal than an economical view, as it is thought to have a wholesome effect upon the blood, particularly of scrofulous persons. Acorn coffee is, however, made and used in many parts of Germany for the sole purpose of adulterating genuine coffee.

ON THE VARIETIES OF PLANTS WHICH CAN FURNISH FIBERS FOR PAPER PULP.

The following paper was read before the British Association by M. Claussen, well known in connection with the flax-cotton experiment:—

What paper-makers require is as follows:—

They require a cheap material, with a strong fiber, easily bleached, and of which an unlimited supply may be obtained. I will now enumerate a few of the different substances which I have examined for the purpose of discovering a proper substitute for rags. Rags containing about 50 per cent. of vegetable fiber mixed with wool or silk are regarded by the paper-makers as useless to them, and several thousand tons aré yearly burned in the manufacture of prussiate of potash. By a simple process which consists in boiling these rags in caustic alkali, the animal fiber is dissolved, and the vegetable fiber is available for the manufacture of white paper pulp. Surat, or Jute, the inner bark of *Corchorus indicus*, produces a paper pulp of inferior quality bleached with difficulty. Agave, *Phormium tenax*, and banana or plantain fiber (Manilla hemp), are not only expensive, but it is nearly impossible to bleach them. The banana leaves contain forty per cent. of fiber. Flax would be suitable to replace rags in paper manufacture, but the high price and scarcity of it, caused partly by the war, and partly by the injudicious way in which it is cultivated, prevents that. Six tons of flax straw are required to produce one ton of flax fiber, and by the present mode of treatment all the woody part is lost. Nettles produce 25 per cent. of a very beautiful and easily bleached fiber. Palm leaves contain 30 or 40 per cent. fiber, but are not easily bleached. The Bromeliaceæ contain from 25 to 40 per cent. fiber. *Bona-*

partea juncoidea contains 35 per cent. of the most beautiful fiber known; it could not only be used for paper pulp, but for all kinds of manufactures in which flax, cotton, silk, or wool are employed. It appears that this plant exists in large quantities in Australia, and it is most desirable that some of our large manufacturers should import a quantity of it. The plant wants no other preparation than cutting, drying, and compressing like hay. The bleaching and finishing it may be done here. Ferns give 20 to 25 per cent. fiber, not easily bleached. Equisetum from 15 to 20 per cent. inferior fiber, easily bleached. The inner bark of the lime-tree (Tilia) gives a fiber easily bleached, but not very strong. Althea and many Malvaceæ produce from 15 to 20 per cent. paper pulp. Stalks of beans, peas, hops, buckwheat, potatoes, heather, broom and many other plants contain from 10 to 20 per cent. of fiber, but their extraction and bleaching present difficulties which will probably prevent their use. The straws of the cereals can not be converted into white paper pulp after they have ripened the grain, the joints or knots in the stalks are then so hardened that they will resist all bleaching agents. To produce paper pulp from them they must be cut green before the grain appears, and this would probably be not advantageous. Many grasses contain from 30 to 50 per cent. of fiber, not very strong, but easily bleached. Of indigenous grasses the rye grass contains 35 per cent. of paper pulp; the phalaris 30 per cent.; arrenatherum 30 per cent.; dactylis 30 per cent., and carex 30 per cent. Several reeds and canes contain from 30 to 50 per cent. of fiber, easily bleached. The stalk of the sugar-cane gives 40 per cent. of white paper pulp. The wood of the coniferæ gives a fiber suitable for paper pulp. The leaves and top branches of Scotch fir produce 25 per cent. of paper pulp. The shavings and sawdust of wood from Scotch fir gives 40 per cent. pulp. The cost of reducing to pulp and bleaching pine wood will be about three times that of bleaching rags. As none of the above named substances or plants would entirely satisfy on all points the wants of the paper-makers, I continued my researches, and at last remembered the papyrus (the plant of which the ancients made their paper), which I examined, and found to contain about 40 per cent. of strong fiber, excellent for paper, and very easily bleached. The only point which was not entirely satisfactory was relative to the abundant supply of it, as this plant is only found in Egypt. I directed, therefore, my attention to plants growing in this country; and I found to my great satisfaction that the common rushes (*Juncus effusus* and others) contain 40 per cent. of fiber, quite equal, if not superior, to the papyrus fiber, and a perfect substitute for rags in the manufacture of paper, and that one ton of rushes contains more fiber than two tons of flax straw.

HOOKER'S PLANTS OF BRITISH INDIA AND THE HIMALAYAS.

In the years 1848–50 an enterprising and perilous mission was undertaken, under government auspices, Dr. Hooker, of England, with the view of exploring the botany of British India, and collecting specimens of its plants. Starting from Calcutta the traveler proceeded first to Behar, ascended the Soane Valley, and crossing the Kymor range to Mirzapur, descended the

Ganges, and proceeded to Sikkim. The plants collected during this journey amounted to 1000 species. The summer of 1848, and the greater part of 1849, were then spent by Dr. Hooker in the Sikkim and East Nipal Himalaya, during which time he botanized the whole country from the plains to the Tibetan frontier, with an assiduity that accumulated an herbarium of 3,500 species; and in December of that year he was met at Dorjiling by Dr. Thomson, who had been botanizing in the plains and mountains of North-West India for seven years previously. Before quitting England, Dr. Hooker had already made a voyage to the south polar seas, with Sir James Clark Ross, in the ill-fated *Erebus* and *Terror*, and having published a Flora of the principal antarctic islands in a style of minuteness that signally qualified him for further research, the travelers met upon equal ground, so far as experience and the scientific knowledge of their favorite pursuits were concerned, and resolved to botanize in company. In May, 1850, Drs. Hooker and Thomson set off together to the Khasia Hills, where the summer was spent, their joint collection of plants amounting to 3,000 species, and in November of that year they visited Silhet and Cachar, and descending the Megna to the Bay of Bengal, proceeded to Chittagong, returning by the Sunderbunds to Calcutta. At Calcutta they embarked for England with an herbarium of 8,000 species of plants, comprising not only many varieties of most of the species, but also many individual specimens of most of the varieties. On the arrival of the travelers in England with so complete a collection of the plants of British India, formed as it was with a high philosophic knowledge of the variability of species, accompanied by drawings and dissections, and by voluminous notes indicative of distribution, habit, and structure, botanists were anxious that no time should be lost in making so unprecedented a mass of materials available to science. The enterprising botanizers were not less urgent themselves to publish the fruits of their researches, but the labor of sorting and identifying the named species, and of unraveling the synonomy of each, to say nothing of describing those that were new, presented obstacles which only time and the command of considerable funds would enable them to encounter. The subject was brought before a Committee of the Natural History section of the British Association at the meeting of 1851, and the members were unanimous in memorializing the Directors of the East India Company for their aid in behalf of the undertaking. The application was, however, unsuccessful, and Drs. Hooker and Thomson have since undertaken the task at their own expense, and as the first product of their labors have published, during the past year, a beautiful volume of 560 pages.

To give an idea of the labor of these assiduous botanists in the field, we may mention that the specimens were all ticketed as they were collected, with particulars of locality and elevation, and in Sikkim and the Khasia Hills 500 specimens of wood were cut, palms, bamboos, and tree-ferns being preserved entire, while colored drawings and dissections of upward of a thousand species were made by Dr. Hooker from the living plants. But the work of collecting material in the field has been surpassed, even thus far, in extent by the labor of analysis in the closet. The number of books and periodicals in which Eastern plants have been described is immense, and all have to be

consulted and studied. No less than 120 authors' names are attached to the 430 species described in the present volume, and upward of 1000 volumes will have to be referred to before the "Flora" is completed. A large proportion of the plants of India have, moreover, proved identical with those of other countries, and in every large genus the authors have had to make a critical study of the European, Siberian, Chinese, and Japanese floras, eliciting results of interest totally unexpected, and of the highest importance in their bearings on the science of botanical geography.

FLAX AND HEMP CULTIVATION IN EUROPE.

The importance of the rettery system of treating flax, as enabling the grower to sell his flax-crop without becoming involved in the processes of steeping, drying and scutching, is evidenced in the fact that large retteries are now at work in England, Scotland, France, Belgium, Holland, Austria, Prussia, and Bavaria. Fourteen steeping establishments are now in operation in Ireland, carrying out the modern patented methods of treatment. In some, a portion of the straw is steeped in open-air tanks, but all of them press the flax-straw between rollers after its removal from the steep, and from this treatment the fiber shows a marked improvement. The present unmechanical process of scutching seems to be now getting some improvement, for the attention of very many inventors has been drawn to the subject. The government returns show the number of scutching-mills in Ireland, in 1852, to have been 1,056; there having been, in 1852, but 956 mills. The *Belgium Instructor* reports thus on the growth of hemp:—"From personal observation, I have arrived at the opinion that hemp can be only grown profitably in Ireland in the following manner:—It should be sown after potatoes, the field being thoroughly cleansed while digging that crop. The hemp-crop can be followed by a flax crop. The hemp should receive some artificial manure—such as guano, or rape-cake dust—at the sowing period, to create a quick stimulus to the young plant, the manure to be applied with the seed. The seed should not be sown either broadcast or in drills, but with the usual wheat-sowing machine, and covered crossways with the roller; or better still, plowed in, in the same way as wheat, along with the artificial manure, so that the crop will be in drills of three or four inches apart. As only 140 plants at most are required per square yard, and each pint contains 10,570 seeds, it follows that 32 quarts would be sufficient quantity of seed per statute acre: but I would recommend an increase of one fourth that quantity for the following reasons: —Experience has shown clearly that, although the female plant is the most vigorous at the ripening period, the male plant will take the lead until it arrives in blossom: that the male forms about one fourth of the whole crop, and possesses little fiber, and that of inferior quality, reaching maturity fully four weeks before that of the female. By pulling the whole crop at the ripening period of the female, the male plant becomes valueless. By taking a medium—that is, two weeks after the ripening of the male, and two weeks before that of the female—the valuable seed is sacrificed, and the straw steeps unevenly, with a mixed fiber of inferior quality. To obviate these evils, a

very simple plan may be adopted. By sowing the crop in drills, as described above, a fourth of the plants can be easily removed; and as the male takes the lead, by simply pulling the most advanced plants at the time the crop is 6 to 12 inches high, it will turn out an almost female crop, securing the greatest yield in both seed and fiber, without any after trouble in the treatment between the plants of each sex. Experiments have also proved the possibility of taking off the seed by the ordinary thrashing-machine, provided an even crop be obtained: and that the hemp-straw can be scutched in the common flax-scutching mill, by simply having the diameter of the beaters, to which the wipers are attached, enlarged.

ON THE INFLUENCE OF LIGHT ON THE GERMINATION OF SEEDS.

At the British Association, Dr. Daubeny gave an account of some experiments on the germination of seeds—the object of which was to determine whether the opinion that this process is most favored by the chemical rays of light, be well founded or otherwise. Five sets of experiments were instituted for this purpose, in each of which from 40 to 60 seeds, of several different kinds, were exposed to the action of light transmitted through different media. In a south aspect, indeed, light which had passed through the ammonia-sulphate of copper, and even darkness itself, seemed more favorable than the whole of the spectrum; but this law did not seem to extend to the case of seeds placed in a northern aspect, where the total amount of light was less considerable. Nor did there appear to be any decided difference in those cases where the *band* of light was different, the quantity transmitted being nearly the same. From these experiments Dr. Daubeny deduces the conclusion, that light only affects germination in so far as it induces a degree of dryness unfavorable to the process; and this he believes to be accordant with the experience of maltsters.

Dr. Gladstone stated that he had performed a series of experiments on the same subject, and had come to the same conclusions as Dr. Daubeny. He found that plants growing under the influence of yellow light produced larger roots than those in other colored light.

CULTIVATION OF QUINA IN JAVA.

Some time since, under the direction of Professor Miquel, of Amsterdam, the Dutch government undertook the cultivation of the Quina or Peruvian-bark-tree in Java. The experiment, by the last accounts, has proved entirely successful. The young plantations established in the mountains thrive extremely well. Lately, M. Karl arrived in Java with a whole ship-load full of young plants and seeds from Peru; so that in a few years Java will be able to supply almost as much quina-bark as is wanted, which is the more a matter of congratulation, as the quina forests in South America are fast approaching their entire extermination.

ZOOLOGY.

ON THE RELATION OF CELLS TO CONSCIOUSNESS AND MUSCULAR MOVEMENTS.

At the meeting of the British Association, Dr. Laycock communicated some of the views he entertained as to the relations of cells to consciousness, and to the adaptation in the movements and functions of organisms to a definite object. These phenomena are variously interpreted in relation to consciousness. While, on the one hand, it was a firmly established opinion that vegetable organisms had no sensation, although they adapted themselves, often with exquisite skill to external circumstances, of which Dr. Laycock adduced several examples—on the other, it was an equally fixed doctrine that the lower animal organisms (*e. g.*, insects) were as susceptible of pain as man himself. Now all these adaptive phenomena were manifested in the highest degree in that ultimate constituent of animated beings, namely, the microscopic cell; and that whether the organism was unicellular, or composed of groups of individual cells, or evolved from a primordial cell, there did not appear the slightest ground for concluding that these were endowed with consciousness; it followed, therefore, that the whole of their adaptive phenomena were the result of a force inherent in them, but distinct from mind. The entire structure of the higher organisms, whether vegetable or animal, being evolved out of cells, and the aim of their whole vital activity being directed to the attainment of the same object as that aimed at in cell action, viz., the well-being and happiness of the individual, it follows that in these that object may be aimed at wholly independently of the will or the consciousness. Such appears to be the case with vegetable organisms; but to determine the presence or absence of these in plants, and even the lower animals, is necessarily beyond the reach of observation. It may be argued, indeed, from analogy, that they may possess a sense of pleasurable existence, inasmuch as such an endowment would be entirely compatible with that grand scheme of beneficent adaptation upon which all organisms and the entire creation are arranged. As to insects, experiments show that it is at least very doubtful whether they feel pain; while the infinite variety of instruments supplied to them to administer to their own happiness, and the inherent skill which they display in the use of those instruments (illustrated by the mathematical accuracy with which the domestic bee constructs its hexagonal cell), might serve as some

proof of the pleasure they may have in existence. Dr. Laycock next proceeded to place the seat of these adaptive movements in the cells of the vesicular neurine which constitute the ganglia of the nervous system, and to show that these could react as a co-ordinating apparatus upon the instrument provided by Divine Providence for the well-being of the animal. He stated that the seat of consciousness is almost universally acknowledged to be in the ganglia within the cranium of Vertebrata; yet the headless trunk of a frog would leap away if it were irritated, or swim away if thrown into water. Hence the conclusion that the cells of the vesicular neurine act, under given circumstances, as adaptively and yet as unconsciously as in the lowest forms of animal and vegetable life. Dr. Laycock then extended these views to the cells constituting the vesicular neurine of the brain, and argued that it might fairly be inferred, both *à priori* and from observation, that their endowments and works of action were not inferior to those of the vesicular neurine in insects. It followed, therefore, that they also might act adaptively and in accordance with their assigned functions independently of the will or consciousness of the individual. To this automatic action (the link between man's spiritual nature and the external world) Dr. Laycock referred the phenomena of mesmerism, electro-biology, spirit-rapping, etc., and expressed his conviction that the derangement of the intellect which those phenomena implied could not be altogether harmless, but might lead, and, indeed, had led to permanent injury to the brain.

ANALYTIC MORPHOLOGY.

The following is an abstract of a paper read before the American Association, by Professor Peirce:

Analytic morphology, said Professor Peirce, is the science of organized forms, whether those made by the Deity or those made by man. It seemed to him the only way for us to understand the organization of the universe was that by which we must understand any human work. We would not understand a play of Shakspeare until we tried to construct it over again for ourselves. Then, and then only, could we understand how all the parts of the play belonged together. So with regard to the work of the Deity; it was not possible for us to understand this as an organization until we looked at it from the point of view of the Creator. If it were possible for us to understand at all the reason of our divisions, and what their nature really was, we could only do it by looking at it as the man who knew most looked at it. That man, he thought, would make the world just as he saw it made, supposing it to be a perfect work—a work worthy of being made by Divinity. Under that point of view, suppose that he, knowing nothing of works of architecture, should examine the details of bridges; he would find three forms—truss, arched, and suspension bridges. Considering himself as the maker, he would recur to the materials of which they were formed, and he would perceive immediately that wood, as a material, necessitated a truss bridge; stone, an arched bridge; and iron, a suspension bridge. He would have to make his work correspond to his materials. He took it that the main difference between

organic and inorganic structures was that while an inorganic structure must be in a state of unstable equilibrium, an organic structure must be in a state of stable equilibrium. This, he thought, was the fundamental idea of the structure of almost all organic bodies, and to accomplish this the solid parts were connected together by something more or less approximating to a perfect fluid. He would consider in the case of fluids what would be the grand classification. He had demonstrated that there were but four forms in which one fluid lying in another of equal specific gravity, as in the case of the embryo, would remain in equilibrium and not crowd together in a sphere. The geometer as well as the naturalist was therefore obliged to divide the subject into four parts. One of them would be the form of a ring radiating about its own axes, which he took to be the fundamental idea of the radiata. The molluscs would be represented by an eliptical cylinder, the form of their embryo; the articulata by a cylinder with constrictions at regular distances, a shape produced by the revolution of a wavy line round the axis of the cylinder, and the vertebrata by a double cylinder having a regular side and corresponding to the spinal marrow and the intestinal cavity. The length of the limb would be determined by the vibration of the pendulum. On the ways and means of locomotion there were a great many different points on which light might be thrown by the geometer, not that the geometer had any right to suppose that he was getting at the fundamental idea of the subject, but he was assisting the naturalist.

Professor Agassiz in commenting on this communication said that the work of the system was not ours, but our Creator's. We could not but come to the conclusion, from a consideration of the whole, that it was all devised in order to place man at the head, and millions of ages ago his coming was seen as the culmination of the thought which devised the fishes and the lowest radiata. When we came to the deep conviction that this whole was the combination of these facts in a logical manner, and as whatever intelligence we had was derived from Him and in His image, that coincidence made it possible for us to understand His objects.

ON THE DISTINCTIONS SUPPOSED TO LIMIT THE VEGETABLE AND ANIMAL KINGDOMS.

The following is an abstract of a lecture on the above subject delivered before the Royal Institution by Professor Lankester, F.R.S.:—

In commencing, the lecturer made some general remarks on classification, and pointed out the importance of accurate definitions in order to constitute the classes, families, genera, and species of the naturalist. The importance of defining species was greater than that of larger groups, because these were composed of species. As genera were collections of species, and families collections of genera, so the animal and vegetable kingdoms were but collections of species. The difficulty in distinguishing between the animal and vegetable kingdoms consisted in our imperfect knowledge of the character of species which existed on what might be called the limits of the two kingdoms. The history of the attempts at defining animals and plants, for sys-

tematic purposes, would afford the best idea of the nature of these difficulties. The definition of Linnæus, that minerals grow, plants grow and live, and animals grow, live, and feel, was first examined. In order to apply this definition, the terms growth, life and feeling, required explanation. *Growth* simply indicated increase. The term life could not be defined in such a manner as to render it inapplicable to the physical phenomena of the inorganic world, and at the same time embrace the lowest forms of organized beings. Feeling could not be defined so as to separate the movements evinced by so many members of the vegetable kingdom, on the application of external stimulants, as the movements of the leaves of the sensitive plant, and the closing and unfolding of flowers, from those of the animal kingdom. Such were the distinctions attempted to be made by one who disregarded the use of the microscope.

One of the most obvious distinctions between the organic and inorganic kingdoms was the presence of the cell in the former. Under some circumstances it was not easy to detect the cell, as in certain fossils, and sometimes inorganic matter assumed a cellular form. Another distinction adopted by naturalists, even since the general introduction of the microscope into natural history inquiries, was, that animals moved, while plants were fixed. This distinction, though applicable to the higher forms of plants and animals, was more than ever applicable to the organisms which required the microscope to detect their existence. Recent researches had shown that the motile tissues in animals were composed of the same substance that was found to be present in the cells of all plants, and which under the names of nucleus, cytoblast, primoidial utricle, and endoplast, had been recognized by all vegetable physiologists. This substance composed of protein, was as actively motile in the plant as in the animal. It was this substance that gave motility to the cells of protococcus, the fibers of oscillaria, the spores of various Confervæ and fungi, and probably also to all other movements observed among plants. When cilia were originally discovered as the agents of movement in infusoria, and upon the internal organs of higher animals, they were regarded as characteristic of animal life. These organs were now known to be present in the zoospores of various Confervæ, and were active agents of movement in the Volvox globator, of whose vegetable nature there could be but little doubt.

The possession of what were called eye-spots in doubtful organisms had been brought forward to decide the animality of these beings. Such eye-spots as present red points in certain stages of the growth of volvox, and other undoubtedly vegetable organisms, and according to Henfrey, were due to the relation of the contents of the cell to light, were in no way the agents of vision in the cells in which they are found. The definition of Aristotle, that animals possessed a mouth, while plants had none, had recently been revived; and of all merely structural characters it was the one best suited to the purpose of the naturalist. Until recently the exceptions to this definition were numerous; but since the botanist had claimed so large a number of mouthless infusoria, it was more than ever applicable. There were however exceptions, and these are found in the Foraminifera, and other low

organisms which have no permanent mouth. Some of these have the power of forming a temporary sac for the purposes of digestion.

Chemistry had from time to time offered its aid to the naturalist. At one time the possession of *cellulose* by the vegetable kingdom was considered distinctive, and the ready application of iodine and sulphuric acid as the test of its presence rendered it an easily ascertainable diagnostic mark. Cellulose has, however, been detected in some species of mollusca and in the brain and spleen of man. Chlorophyll also appeared at one time to pronounce the presence of plants; but this has been found in animal organisms. Starch was another vegetable product easily detected by iodine, whose universal presence in the plant seemed to offer the best practical chemical test; but starch has been detected in the brain of man, and there is reason to suppose it might be very generally present in the animal kingdom. It was thus seen that no one point in structure or chemical composition could furnish a means of distinction. A physiological point of much interest and importance had principally determined a certain number of botanists in claiming the Diatomaceæ and Desmideæ as plants. In certain Confervæ it had been observed that previous to the production of the zoospore two contiguous cells united, and each contributed its contents to form the germinating spore.

Whatever might be the difficulties presented in any individual case, in the application of any or all of the before-mentioned distinctions, there was evidently a great antagonism or polarity exhibited by the animal and vegetable kingdoms, viewed as a whole. They were mutually dependent, attained the same end in their growth and organization, but by contrary means. The great function of the animal tissues was the absorption of oxygen and the disengagement of carbonic acid. The great function of the vegetable tissues was the absorption of carbonic acid and the disengagement of oxygen. The processes in the history of the life of the two kingdoms in which these distinctive functions appeared to be reversed, were not exceptions to the law, but were due to other agencies than those connected with the essential life of the plant or animal. Thus, carbonic acid was given out by plants at night during fructification and germination. In the first instance, the gas given out was that which has been taken up during the day, and was not decomposed by the agency of light. In the latter instance, a process of exudation took place, in which the contents of the cells were undergoing change independent of the life of the plant. The germ, during the growth of its cells, absorbed carbonic acid and gave out oxygen, as in the growth of all other vegetable cells. The development of the carbonic acid arose from the decomposition of the starch and sugar of the albumen of the seed. In cases where animals had been found to give off oxygen, it was doubtful as to whether plants were not present, or even mistaken for animalcules. Attention was drawn to the fact that in all cases vegetable compounds are formed from carbonic acid and water, or from carbonic acid, water and ammonia, by the loss of oxygen. Acetic acid was referred to as an exceptional instance; but it was shown that it was more probable, where acetic acid occurred as the result of vegetation, that it occurred as a result of deoxydation than of a process of fermentation in which alcohol was developed and subsequently

oxydized. An exception was also referred to in the animal kingdom, in whieh fat is supposed to be formed by the deoxydation of sugar, but attention was drawn to the fact that this proeess admitted of another explanation not opposed to the physiologico-chemieal distinction pointed out. These proeesses were further shown to be eonnected with the relations existing between the animal and vegetable kingdoms. The plant was produeed from mineral compounds—earbonie acid, water and ammonia—the substanees out of which the animal was formed; and no instance was known of the animal appropriating and forming organic substanee out of these compounds. This was the distinguishing feature of the life of the plant, and the liberation of oxygen gas its most constant result. The appropriation of substances thus formed, and the uniting them onee more to oxygen was the distinguishing feature of animal life, and the formation of earbonic acid gas its most constant result. Minor ehanges oeeurred; but these were the grand distinguishing features of the two kingdoms, the recognition of whieh by structure, function, or results, could alone enable us to distinguish between plants and animals.

ON THE INFLUENCE OF INDUSTRIAL OCCUPATIONS ON THE EYES.

The London Soeiety of Arts some time sinee instituted an inquiry respecting the effeet of industrial employments on the bodily health of particular organs, and commeneed their undertaking with an inquiry into the "industrial pathology of trades which affect the eyes." From a lengthened report on this subjeet to the Soeiety we make the following extracts. Mr. Dixon, surgeon to the Royal Ophthalmie Hospital gives as his opinion that weakness of sight, as a general thing, is owing to over-use of the eyes, and not to any special employment of them, sinee every day's experience teaehes us that the most trying work for the eyes may be followed, provided due moderation is observed.

Tailors, it is stated are most liable of any class to exhaustion of visual power from over-use of the eyes. Needlewomen and dressmakers come under the same head. It is suggested that needlewomen, embroiderers, ete., should work in rooms hung with green, and having green blinds and eurtains to the windows. In China this rule is adopted by the exquisite embroiderers of that eountry. Needlewomen would also find it greatly to their advantage to change the color of their work as often as possible. The *rationale* of this is found in the law that variation of stimulus is neeessary to preserve the tone and health of any organ of sense, and that prolonged application of the same stimulus exhausts it.

Injurious consequenees to the eyes often result from long eontinuanee of work in the sitting posture. Congestive diseases of these organs are indirectly attributable to this eause, which produces stasis of the eirculation, in the abdominal organs, and seeondary venous eongestion of the choroid coat.

Among all classes of persons oeeupied in various ways upon minute objects, instanees oecur in which the fatigue and distress of the eyes arises not so mueh from the actual amount of work, as from the patient's attempting to

execute it, after a certain time of life, without the assistance of glasses suited to correct the gradual change of focus which the eye itself undergoes. Some persons even in early life—in childhood—who have very acute sight for distant objects, require the aid of slightly convex glasses, to enable them to sustain, for any considerable time, the effort of observing minute objects which are near them. This assistance is still more frequently necessary in adults who have passed the age of fifty. With convex glasses, accurately adapted to their peculiar focus, such persons are frequently able for many hours to follow their occupation of needlework, when, without such aid, their sight would wholly fail after a few minutes' application. In a like manner, short-sighted persons suffer from attempting to work without suitable concave glasses.

Dr. Caplin, of Manchester, says:—If we take the trouble to investigate the effect of light on the eye, we shall find that it is not so injurious as it is generally thought. An organ, whatsoever it may be, is not injured so long as it can perform its functions with facility. The stress on the eyes results from *want of light*, and whenever the light falls on the object we want to see, and not on the eyes themselves, it does not prove hurtful. I have known many persons accustomed all their lives to most minute work, such as engraving, whose eyes were neither affected nor impaired. This fact is in accordance with the law of physiology, by which the strength of an organ is in proportion to its activity. Oblique and bad light are the cause of affection. But it may be remedied by altering the window, or changing the place or position of the worker. The question whether the eye or any of the other organs of sense, is capable of improvement in proportion to its use, or whether like a human mechanical contrivance it wears out by employment, is a very serious one. A great deal of our conduct in daily life depends on the way we answer it to ourselves. It is probable that the "wearing out" contrasted in the popular saying, with "rusting out,' is often falsely attributed to the human body, and that perfectly healthy organs are made more efficient by use—provided that such use does not diminish the nutrition of the system; but at the same time local injury is certainly experienced in many parts of the body, especially the eye, by working too long hours. The explanation appears to be this, viz., that after the body has been long employed, sufficient vigor does not remain in each separate organ to enable it to do its duty—it can not be called healthy after the general strength is exhausted. Overworking the eyes, means working with the eyes in an unnatural condition.

In using artificial light, the light should be above the level of the face, so as to allow, as in nature, the brow, the lashes and the iris to shelter the pupil, and thereby the expansion of the optic nerve from the direct rays. Neglect of this precaution is injurious in two ways: first, the influx of such rays continued for a considerable period tends to exhaust the normal susceptibility of the retina; and, secondly, by eclipsing the brilliancy of the rays reflected from the work, so that the workman is induced to increase the light to a degree otherwise superfluous, dazzling and pernicious.

The following suggestions have been made in regard to the prevention from injury of the eyes from artificial light. 1. Color of the light. To fully understand the object to be attained, it is necessary to bear in mind that daylight

is composed of three primary colors in the following proportions:—yellow, 3, red 5, blue 8. The red and yellow rays are the most exciting to the eyes, and in proportion as artificial light possesses them in excess, it is fatiguing and injurious to those organs. The bad effects, however, may be obviated, 1st, by surrounding the flame with a chimney tinged pale blue; 2d, by surrounding the light with a shade colored azure blue on the inner side. In these contrivances the color of the light is improved by the addition of the deficient blue rays. 2. Position of the light. A frequent cause of the injurious effects of artificial light is the direct and concentrated manner in which it is permitted to fall upon the eyes. No light should be placed in front of the eyes, but it should be either above the head, or rather behind, and on one side, so that the object can be well illuminated, while the eyes are fully protected from the heat and glare. 3. Unsteadiness of the flame. The steadier the flame the better for the eyes; lights should therefore have glass chimneys to assist combustion and prevent flickering. 4. Heat and dryness. This can not be avoided in rooms heated with hot air, nor where there are many lights; but it may be obviated by placing in some convenient situation a flat dish containing water; and those engaged in work requiring a strong light should place a large wet sponge near them, to cool and moisten the air by evaporation. It may be also remarked that full blue and green glasses, which are often worn by persons having weak eyes, are highly objectionable, being of definite colors, and exciting complementary colors. Neutral-tinted glasses, being, as the name implies, of no definite hue, screen the eye from all colors alike, and produce an effect most grateful to irritable eyes.

PEARLS AND PEARL-MAKING IN CHINA.

The following information respecting the method adopted by the Chinese for facilitating and shaping the growth of the pearl in the pearl-oyster is communicated to the *Journal of the London Society of Arts*, by Dr. Macgowan:

The practice of the art is confined to two coterminous villages near the district city Tehtsing, in the northern part of Chihkiang, in a silk producing region. In the month of May or June large quantities of the mussel (Mytilus cygnus) are brought in baskets from the Táhú, a lake in Kiangsú, about 30 miles distant, the largest among the full-grown being specially selected. As their health suffers on the journey they are allowed a few days' respite in bamboo cages in water before being tortured for the gratification of human vanity, when they are taken out to receive the matrices. These are various in form and material, the most common being pellets made of mud taken from the bottom of water-courses, dried, powdered with the juice of the camphor-tree seeds, and formed into pills, which, when dry, are fit for introduction into the unfortunate subject. Moulds which best exhibit the nacreous deposit are brought from Canton, and appeared to be made from the shell of the pearl-oyster; the irregular fragments thus procured are triturated with sand in an iron mortar until they become smooth and globular. Another class of moulds consists of small images, generally of Buddha, in the usual sitting posture; or sometimes of fish. They are made of lead, cast very thin by pouring on

a board having the impression. Pearls having these forms have excited much surprise since they first attracted the attention of foreigners a few years back.

The introduction of the pearl nuclei is an operation of considerable delicacy. The shell is gently opened with a spatula of mother-of-pearl, and the free portion of the mollusc is carefully separated from one surface of the shell with an iron probe; the foreign bodies are then successively introduced at the point of a bifurcated bamboo-stick, and placed in two parallel rows upon the mantle or fleshy surface of the animal. A sufficient number having been placed on one side the operation is repeated on the other. Stimulated by the irritating bodies, the suffering animal spasmodically presses against both sides of its testaceous skeleton, keeping the matrices in place. This being done the mussels are deposited one by one in canals, or streams or pools connected therewith, five or six inches apart, at depths of from two to five feet, in lots of from five to fifty thousand.

If taken up a few days after the introduction of the mould these will be found attached to the shell by a membranous secretion which, at a later period, appears as if impregnated with calcareous matter; and, finally, layers of nacre are deposited around each nucleus, the process being analogous to the formation of calculary concretions in animals of a higher development. A ridge of marl generally extends from one pearly tumor to another, connecting them all together.

About six times in the course of the season several tubs of night-soil are thrown into the reservoir for the nourishment of the animals. Great care is taken to prevent goat manure from falling in, as it is highly detrimental to the mussels, preventing the secretion of good nacre, or killing them, according as the quantity may be great or small.

In November the shells are carefully collected by the hand, the muscular portion removed, and the pearls detached by a sharp knife. If the basis of the pearl be of nacre it is not removed, but the earthen and metallic matrices are cut away, melted yellow resin poured into the cavity, and the orifice artfully covered by a piece of mother-of-pearl. In this state these more than semiorbicular pearly pellicles have much of the luster and beauty of the solid gem, and are furnished at a rate so cheap as to be procurable by all who care to possess them. They are generally purchased by jewelers and others, who set them in tiaras, circlets, and various ornaments of female attire. Those formed on the image of Buddha are finished in the same manner, and are used as ornaments and amulets on the caps of young children. A few shells are retained, with their adhering pearls, for sale to the curious or superstitious, specimens of which have by this time found their way into the principal public and private cabinets of Europe and America. They are generally about 7 inches long, and 5 broad, containing a double or triple row of pearls or images—as many as 25 of the former and 16 of the latter to each valve. That the animal should survive the introduction of so many irritating bodies, and in such a brief period secrete a covering of nacre over them all, is certainly a striking physiological fact. Some naturalists, indeed, have expressed strong doubts as to its possibility, supposing the pearls were made to adhere to the shell by some composition, but the examination of living specimens in differ-

ent stages of growth, having both valves studded with pearls, has fully demonstrated its truth. A tinge of yellow is found over the whole inner surface of some shells, showing that the more recent secretion of nacre by the suffering animals was unnatural; the flesh of all, however, is eaten.

Above five thousand families are represented as being engaged in this singular branch of industry in the villages of Chungkwan and Sian-chang-ngan; they, however, mainly derive their support from cultivating the mulberry, and in rearing silk-worms, and other agricultural occupations. Those who are not expert in the management of the shells lose 10 or 15 per cent. by deaths; others lose none in a whole season.

NEW THEORY RESPECTING THE CHOLERA.

A work of considerable importance has been published in Germany during the past year by Dr. Max Pettenkober, bearing the title: "Investigations and Observations in regard to the Propagation of Cholera, with Reflections on the proper means of arresting its Progress." The author is Professor of Medicinal Chemistry at the University of Munich, and has been employed by the government during the whole of last year investigating the progress and mode of propagation of the disease in the principal towns of Bavaria. The present work is the result of his and other physicians' researches, in the form of a report to the government, and has given such complete satisfaction that its gratuitous distribution has been ordered throughout the kingdom at the expense of the government.

The author advances no new theory, but produces a volume of facts of a most positive and conclusive character. These facts could hardly have been ascertained with the same precision in any other country; for not only would it have been impossible to ascertain age, condition, mode of life, etc., of the sick, but the patients themselves would not willingly have subjected themselves to a similar control. Observations were made in Munich, Nuremburg, Augsburg, Wurzburg, Ebrach, Ingolstadt, Gaimersheim, Rattisbone, Fraunstein, and Freysing, and the author compares his results with the "Report of the Mortality of Cholera in England, 1848–49," and the reports on the cholera in India, during the years 1817, 1818 and 1819, by James Jameson. He shows conclusively that there is no contradiction in these reports—that the facts ascertained in India are precisely those which have been observed later in England, and but last year in Bavaria; that any apparent contradiction is due solely to accompanying circumstances by which the results were modified, and which in part are mentioned by the authors themselves. The facts which Dr. Pettenkober claims to have fully established are as follows:—

1. That it is not contagious, in the usual sense of the word; but that it can, nevertheless, be carried from one place to another.

2. That it always follows the usual routes of commerce.

3. That no elevation above the level of the ocean, furnishes a guaranty against the disease nor is any depth necessarily exposed to its ravages.

4. That no contagious cholera matter is floating in the atmosphere, and that consequently the disease is not propagated by currents of air.

5. That it is not propagated through the water.

6. That it is propagated through the earth.

7. That the earth receives and develops the cholera contagion from the excrements of diseased persons.

8. That excrements from a diseased person thrown into a sink or privy, are capable of transforming the whole mass into a hearth of cholera contagion.

9. That the gases disengaged by the decomposition of organic substances, especially of excrements, penetrate the earth, rise to the surface, and become then the cause of fevers and of cholera.

10. That there has not been a single case of cholera observed in Bavaria that could not be traced to that species of infection.

11. That the stools of persons afflicted with cholera, or that peculiar species of diarrhea which usually precedes cholera, are more infectious than those who are actually seized with the disease.

12. That cholera is always carried to a place where it has not yet appeared by a diseased person, and communicated through excrements brought in contact with the earth; and that there is no other way of propagating the disease. Immediate contact with the patient, inhaling the air of the sick-room, washing of the dead body, nay, even dissecting it after death, does not communicate the disease.

13. Not every species of earth acts on the process of decomposition in like manner, and the capacity for spreading the contagion in the manner above stated varies in consequence with the composition of the soils on which dwellings are built. On rocky foundation, granite or sandstone, cholera never becomes epidemic. An alluvial soil, underlaid with lime or clay, or any other cause which keeps the ground moist, may become a teeming womb for the cholera contagion.

14. The cholera poison may be in a person from one to twenty-eight days without manifesting itself. This fact furnishes a measure for the distance to which it may be carried from one place to another.

15. The disease which is not communicated by contact is carried to the inmates of houses, sleeping in rooms exposed to the cholera poison as above engendered.

16. If the cholera, as proved in London, is more intense and fatal in the plain than on elevations, it will, on investigation, be found that it is owing to the better drainage, by which filth is removed before it is decomposed, or before it enters, as in damp and wet soils, into process of fermentation. Dr. Pettenkober found some of the worst cases of cholera on hills where the privies of houses still higher situated emptied into sinks or sewers of improper fall. The upper houses were generally exempt.

17. To prevent contagion, the stools of cholera patients must be disinfected before they are emptied. The best disinfecting agent is vitriol of iron. Chloride of lime only purifies the air, but does not destroy the cholera poison.

18. When strangers from cholera districts are expected to arrive, the privies of hotels and boarding-houses where they are expected to put up, ought to be disinfected with vitriol of iron—say once a-week. In the rooms and corridors of hospitals, turpentine may be spread on paper and exposed to

the atmosphere. The ozone (electrified oxygen) thus given out is the best purifier of the atmosphere.

19. Care must be had not to allow any linen to be washed which is soiled with the excrements of a cholera patient. The process of maceration to which soiled clothes are usually subjected is capable of developing and communicating the disease in its worst form. Jameson found the same truth in 1817, '18 and '19 in India, without tracing it to its source.

20. There are no other sanitary regulations capable of preventing or arresting cholera in its progress, than those which have reference to cleaning and purifying those places which serve to collect or convey human excrements.

ON THE ANATOMY OF THE TORPEDO.

Professor J. Wyman recently presented to the Boston Society of Natural History the result of some observations on the torpedo, well known for its electrical powers. His attention had been particularly directed to the termination of the nerves in the laminæ which compose the efficient part of the battery. The plates consist of an exceedingly thin membrane which appears to be nearly homogeneous, its surface showing only traces of striations. On this membrane are distributed ultimate nerve fibers and capillary vessels. When the primitive nerve-tube reaches the plate it breaks up into numerous fibers, and these in turn subdivide and reunite so as to form a regular network over the whole surface. Professor Wyman estimated the whole number of the plates at between 250,000 and 300,000. There were about 100 to the inch in each electric prism, which is less than the number counted by Mr. Hunter, viz., 150 to the inch. The number of prisms in each battery was about 1,200, each prism measuring from 1 to 2 inches in height. The interval between the plates was filled with a fluid consisting of about 90 per cent. of water, containing albumen and common salt in solution. On examining the contents of the stomach, it was found that during the process of the digestion of the bones, the calcareous matter was removed before the gelatinous matter was dissolved, and Dr. Wyman had noticed the same result in the dissection of other fishes. This is the reverse of what occurs in dogs and hyenas, where the gelatinous matter alone is removed, the calcareous matter not being dissolved. The stomach of the specimen had been acted upon by the gastric fluid after death, and was perforated in its large curvature. Hydrochloric acid was detected in its contents.

Professor Rogers alluded to the analogy betweeen this animal battery and the ordinary metallic battery. The nervous tissue might act both as generator and conductor, generating in its minute ramifications, and conducting by its larger branches. The disproportionate quantity of nervous tissue would not be an objection to this, as batteries are constructed in which the copper-plate bears but a small proportion in size to the zinc, not more than one-twelfth perhaps, which yet exert a powerful effect, especially when a hot acid is employed.

FOUNTAIN OF BLOOD IN HONDURAS.

In the *Annual of Scientific Discovery* for 1855, a description derived from *Silliman's Journal* of the so-called "Fountain of Blood," in Honduras, was given, without any explanation of the observed phenomena.* In the Journal for March, 1855, a letter is published from Mr. E. D. North, which solves the mystery of the appearances observed. Mr. North says: "The brown liquid which flows from the cavern, according to my examinations, must be *a solution of the dung of bats.* An examination of the liquid under the microscope, even when excessively diluted with water, exhibits various portions of the harder and less destructible parts of insects, together with perhaps occasional fragments of small crustaceans. Since the notice of the fountain mentions that the cavern is frequented by 'vast numbers of large bats (vampyres),' that 'the liquid has the color, smell, and taste of blood,' (of course we may make large allowance for exaggeration), and that 'dogs eat it eagerly,' we may conclude that the vampyres gorge themselves to such an extent that, as is common with all animals over-fed, much of their food passes without being digested. As to the statement that the 'blood' is found 'in a state of coagulation,' a physiologist will withhold his belief until a careful examination by one who knows what the coagulation of blood really is. Evaporation and settling will reduce a solution of any dung to a semi-solid mass."—*Silliman's Journal.*

NEW METHOD OF PRESERVING ENTOMOLOGICAL SPECIMENS.

Dr. Dummer, of Jersey City, has devised a method of preserving entomological specimens by inclosing them in small glass tubes, inclosed and sealed by means of the blow-pipe. This renders the tube air-tight, and forms a receptacle well adapted for preserving insects without spirits, or drying, as in the ordinary way.

Mr. W. S. Van Duzee, of Buffalo, N. Y., also proposes, in *Silliman's Journal*, the following method for the arrangement and preservation of a cabinet of insects. He proposes to take glass-stoppered jars with a large mouth, attach to the under side of the stopper a rectangular strip of cork or soft board (whitened with paper or otherwise) as broad as the stopper and as long as the jar will hold; then arrange the insects on one side of this upright piece. The insects thus arranged would show finely in a collection—could be always on the shelves for exhibition—would be perfectly secure from insects, even without camphor, though it may still be used—and the jars could be easily opened and insects taken out for special examination. Moreover, he suggests that the insects may be numbered on the opposite side of the board, and the names of the species be given.

New Method of Preserving Anatomical Specimens.—At a late meeting of the Franklin Institute, Philadelphia, Dr. John H. Britten stated that he had succeeded, after a series of experiments, in preserving a dissected leg, retaining

* See *Annual of Scientific Discovery* for 1855, p. 362.

the natural size, form, and appearance of the specimen, by coating it with gutta-percha from a solution. The specimen which was exhibited had the appearance of the purest *papier-maché* preparation, and possessed the advantages of presenting not only the natural color of the tissues, but also the relations of the muscles, nerves, vessels, etc.

For detailed account, see *Proceed. Acad. Nat. Sciences, Phil.*

ON THE DESTRUCTION OF MARINE ANIMALS BY CHANGES IN TEMPERATURE.

At a meeting of the Royal Society of Edinburgh, Hugh Miller called attention to the extensive destruction effected last winter of the shell-fish on the coast of Scotland, by a severe frost—coincident at new-moon with a stream-tide. In some places the beaches were covered with tens of thousands, chiefly of two species, a *Solen*, or razor-fish, and a *Mactra*. Other species of shells, equally abundant and exposed to the cold, did not appear to suffer—at least to any great extent. This wholesale destruction by a frost, a few degrees more intense than is common, strikingly shows, how simply by slight changes of climate, induced by physical causes, whole races of animals may become extinct.

Observations on the Preservation of Marine Animals in an "Aquarium."—In a discussion on the above subject before the British Association, Mr. Warrington stated that temperatures below 45° destroyed many forms of animal life, especially Crustacea, while a temperature exceeding 60° Fahrenheit, was destructive of both animal and vegetable life. Too great exposure to light was also destructive of creatures kept in the Aquarium.

Dr. Fleming related, in connection with the subject of keeping animals in sea-water, that he had in his possession an Actinia, originally captured by Sir John Dalyell, that had now been in captivity twenty-eight years.

ON THE ROOSTING OF BIRDS.

At a recent meeting of the Boston Society of Natural History, Professor J. Wyman referred to the commonly received explanation of the manner in which birds retain their position in roosting. Bovelli attributed the bending of the toes to the mechanical action of the salient angles, over which the flexor tendons passed. Professor Wyman thought this gave, at best, but a partial explanation; for, while roosting, the body requires to be accurately balanced, since, at every act of respiration, the center of gravity must necessarily be changed, and the requisite adaptations can be effected by muscular action only. In those waders which roost on one leg, the balancing of the body becomes a matter of still greater nicety; and in these, too, the tibia is not flexed upon the tarsus, therefore the tension of the tendons, as stated by Bovelli, would not be effectually produced. In bending the leg of a dead bird, the toes do not adapt themselves to the surfaces on which they rest. He thought the explanation must be found in reflex muscular action, an explanation which had been suggested to him by Dr. S. Cabot.

ON THE STING OF THE MOSQUITO.

At a recent meeting of the Boston Society of Natural History, Dr. Durkee remarked that one of the most remarkable features in the anatomy of the mosquito is, that the parts which constitute the mouth are elongated so as to form a beak extending horizontally like that of some birds. The beak or sting is about half the length of the body, and to the unassisted eye appears to be very simple in its structure. When examined with the microscope, however, it is found to be composed of seven different parts, which are comparatively stout on one edge. These parts vary in length, and can be separated from each other without much difficulty They are broad at the upper part, where they are united to the head, and they gradually taper to a point. One of the parts is a tubular canal or groove, in which the others are lodged when the proboscis is not in use. Dr. Durkee stated that he had not been able to find any appearance of teeth, except on the two longest pieces; in these he had found them near the tip. The two longest pieces, also, are marked by transverse lines, extending from one edge to the other, throughout their whole length.

ON THE ARTIFICIAL PROPAGATION OF SALMON NEAR PERTH, SCOTLAND.

At the last meeting of the British Association, Mr. Edward Ashworth gave an account of some interesting experiments made upon the river Tay, Scotland, in respect to the artificial propagation of salmon. The experiments were made upon the estate of the Earl of Mansfield, by a company of gentlemen associated for the purpose. A small stream flowing into a mill-pond offered every facility for the equable flow of water through the boxes and pond. Three hundred boxes were laid down in twenty-five parallel rows, each box partly filled with clean gravel and pebbles, and protected at both ends with zinc grating to exclude trout and insects. Filtering beds were formed at the head and foot of the rows, and a pond for the reception of the fry was constructed immediately below the hatching ground. On the 23d of November, 1855, operations were commenced, and by the 23d of December 300,000 ova were deposited in the boxes. The fish were taken from spawning beds in the Tay. So soon as a pair of suitable fish were captured, the ova of the female were immediately discharged into a tub one fourth full of water, by a gentle pressure of the hand from the thorax downward. The melt of the male was ejected in a similar manner, and the contents of the tub stirred with the hand. After the lapse of a minute, the water was poured off, with the exception of sufficient to keep the ova submerged, and fresh water supplied in its place. This also was poured off and fresh substituted previous to removing the impregnated spawn. The ova was placed in boxes as nearly similar to what they would be under the ordinary course of natural deposition as possible, with this important advantage: in the bed of the river, the ova are liable to injury and destruction in a variety of ways. The allu-

vial matter deposited in time of flood will often bury the ova too deep to admit of the extrication of the young fry, even if hatched. The impetuosity of the streams flooded will frequently sweep away whole spawning beds and their contents. While deposited in boxes, the ova are protected from injury, and their vivification in large numbers is thus rendered a matter of certainty, and the young fish are reared in safety. On the 31st of March, 1854, the first ovum was observed to be hatched, and in April and May the greater portion had come to life, and were at large in the boxes; in June they were admitted into the pond, their average size being about an inch and a half in length. From the period of their admission to the pond the fry were fed daily with boiled liver, rubbed small by the hand. Notwithstanding the severity of the winter, they continued in a healthy condition, and in the spring of the year 1855 were found to have increased in size to the average of three and four inches in length. On the 2d of May, 1855, a meeting of the committee was held at the pond, to consider the expediency of detaining the fry for another year or allowing them to depart. A comparison with the undoubted smelts of the river then descending seaward with the fry in the ponds, led to the conclusion that the latter were not yet smelts, and ought to be detained. Seventeen days afterward, viz., on the 19th of May, a second meeting was held, in consequence of great numbers of the fry having in the interim assumed the migratory dress. On inspection it was found that a considerable portion were actual smelts, and the committee came to the determination to allow them to depart. Accordingly the sluice communicating with the Tay was opened, and every facility for egress afforded. Contrary to expectation, none of the fry manifested any inclination to leave the pond until the 24th of May, when the larger and more mature of the smelts, after having held themselves detached from the others for several days, went off in a body. A series of similar emigrations took place until fully one half the fry had left the pond, and descended the sluice to the Tay. It has long been a subject of controversy whether the salmon assume the migratory dress in the second or third year of their existence. In order to test the matter in the fairest possible way, it was resolved to mark a portion of the smelts in such a manner that they might easily be detected when returning as grilse. A temporary tank, into which the fish must necessarily descend, was constructed at the junction of the sluice with the Tay; and as the shoals successively left the pond, about one in every hundred was marked by the abscission of the second dorsal fin. A greater number were marked on the 29th of May than on any other day, in all about 1,200 or 1,300. The result has proved highly satisfactory. Within two months of the date of their liberation, namely, between May 29 and July 31, twenty-two of the young fish so marked when in the state of smelts on their way to the sea, have been in their returning migration up the river, recaptured and carefully examined; the conclusions arrived at are most gratifying, and prove what has heretofore appeared almost incredible, namely, the rapid growth of the young fish during their short sojourn in the salt water; this fact may be considered as still further established by observing the increased weight according to date of the grilse caught and examined; those taken first weighing 5 to 5½ lbs., then increasing progressively to 7 and 8 lbs.;

while the one captured on 31st of July weighed no less than 9½ lbs. In all these fish the wound caused by marking was covered with skin, and in some a coating of scales had formed over the part. Although twenty-two only are mentioned, the taking of which rests on indubitable evidence, nearly as many more are reported from distant parts; the weights and sizes of these have not been forwarded. The experiment at Stormontfield has afforded satisfactory proof that a portion at least of the fry of the salmon assume the migratory dress and descend to the sea shortly after the close of the first year of their existence; and what is far more important in a practical point of view, it has also demonstrated the practicability of rearing salmon of marketable value within twenty months from the deposition of the ova. A very interesting question still remains to be solved. At what date will the fry now in the pond become smelts? Hitherto, they have manifested no disposition to migrate; and if the silvery coat of the smelt be not assumed till the spring of 1856, a curious anomaly will present itself. Some of the fry as smelts will, for the first time, be descending seaward, of the average weight of 2 oz.; some as grilse will be taking their departure to the sea; and others still more advanced will even have completed their second migration, and return to the river as salmon 10 or 12 lbs. in weight. It is much to be desired that the experiment at Stormontfield could be continued for a year or two longer, till the links in the chain of evidence now wanting to complete the natural history of the salmon should be obtained.

NEW ANIMALS FROM WESTERN AFRICA.

At the recent meeting of the British Association, Mr. A. Murray read a paper "On the recent Additions to our Knowledge of the Zoology of Western Africa," in which he notices a new electric fish, called *Malapterurus Benineusis.* Mr. Thomson, who has studied its peculiarities, states that its electrical properties are made use of by the natives as a remedy for their sick children. The fish is put into a vessel of water, and the child made to play with it: or the child is put into a tub of water in which several fishes are placed. It is interesting to find a popular scientific remedy of our own anticipated by the unlettered savage. Mr. Thomson also mentioned an instance of the electric power of this fish, which may be worth mentioning. He had a tame heron which, having been taken young, had never had the opportunity of searching for and choosing its food for itself. It was fed with small fishes; and on one occasion there happened to be a newly-caught electric fish among them, which it swallowed but immediately uttered a loud cry, and was thrown backward. It soon recovered, but could never afterward be induced to dine upon Malapterurus.

Among other interesting fish there is a species of Lophius, or Mud-fish, which appears undescribed. The curious habits of this semi-amphibious family, of crawling out of the water, using their fore-fins like legs, and then sitting staring about with their great goggle eyes, is noticed as very marked in this species. If placed in a basin, it will crawl up the side, and sit on the edge looking about.

ON THE PRODUCTION OF LAC.

At a meeting of the English Asiatic Society, a communication on the habits and uses of the lac insect, was made by General Briggs. The name of the insect is said to have been derived from the well-known Indian word *lakh*, meaning, figuratively any very large amount, expressing the immense number comprising each community. The lecturer noticed, in a general way, the several insects which had been known in Europe for twenty centuries, as producing a red dye; but observed that the lac insect was certainly a different creation. The insects are found upon and supported by a variety of trees. All plants yielding a milky juice served them for food; and it not unfrequently happens that large trees are destroyed by swarms of these insects settling upon them. The natives of India, in collecting the lac, destroy the insect; but Europeans, having found that its cells only are valuable, have devised methods for collecting the products without destroying the producers. The lac is found incrusted around branches or sticks, and is thence called stick-lac. In this crude state it is sold by the collectors at from a farthing to a halfpenny per lb. When separated from the resinous matter and pulverized, it becomes seed-lac. Other processes convert it into lump, plate, and shell lac. The preparation of lac for the London market is chiefly carried on in India by Europeans; and its price varies from eleven pence to two shillings and two pence per lb., according to the locality or factory from whence it comes. In 1809, the quantity imported into England was 40,600 lbs.; but during the last twenty years, the imports of lac-dye have increased 675 per cent., and of the shell-lac 275 per cent. The stock on hand in 1854 was 3,300,280 lbs. of lac-dye, and 2,358,750 lbs. of shell-lac. In India, as in England, it is used as a dye for producing a permanent red color, and also as a pigment and varnish combined, which resists the effect of cold water, and does not wear off. It is used, when colored with yellow orpiment, for making bracelets, chains, and other ornaments, which are scarcely distinguishable in appearance from gold. Lac was first introduced into England in the shape of sealing-wax. As a dye, it produces a color equal to cochineal, and is less liable to change from wet; so that it is now extensively used in the dyeing of red-cloth. It produces also the color called by artists lac-lake. Shell-lac, dissolved in naphtha, is largely employed by hatters in forming the frame or base of the hat. It enters largely into all varnishes and French polish; but one of its most important uses is in the production of Mr. Jeffrey's valuable discovery called marine glue, which consists of a mixture of shell-lac and caoutchouc dissolved in naphtha. Here then was an Indian product, which but a few years ago was unknown in England, but is now an article of very great importance. How many more articles of value produced in our Indian dominions may still be hidden from us, it is impossible to say; but it is to be hoped that the ignorance which still exists respecting them will soon be dispelled, and that improved communications, and greater intercourse with the people of that country, will make known to us other productions valuable alike to us and to them. In the course of the lecture, General Briggs took

occasion to state that the lacquered or japanned goods of China, Japan, Borneo, etc., are not manufactured, as is generally supposed, from the productions of the lac insect, but from a vegetable production—a liquor obtained by making incisions in the bark of certain trees.

ON THE OPATE INDIAN, OR "BEAR-WOMAN."

At a recent meeting of the Boston Society of Natural History, Dr. Kneeland read the following paper, on a so-called Opate Indian, exhibited in Boston, in September, 1855:—

This girl, who is 22 years of age, 4 feet 6 inches in height, and of the weight of 112 lbs., is probably a member of some Indian tribe inhabiting the Sierra Madre Mountains; these mountains run for the most part parallel to the Gulf of California, through the Mexican States of Sonora and Cinaloa; their distance from the sea varies from 200 to 50 miles, and in the neighborhood of Mazatlan they come still nearer to the coast. This girl has been called an *Opate* Indian; if she belong to this tribe, she is from the central part of Sonora. It has also been stated that she was obtained from the Sierra Madre Mountains in Cinaloa, in the neighborhood of Copula. This is, however, of little consequence, as the girl, without doubt, belongs to some one of the Indian tribes between the Sierra Madre Mountains and the Gulf of California, in the Mexican provinces of Sonora and Cinaloa; and whatever may be the particular tribe of a scattered race which may claim her, she is just as much a curious, rare and interesting specimen of *humanity.*

As to her tribe living in caves, in a naked state, on an equality with brutes, and partaking of their food, that would degrade her to a level with the Digger Indians of California, who, though very degraded, are yet far above the brutes. The locality of the Digger Indians is several degrees further north than the Sierra Madre range. This resemblance to the brute is mentioned, as the popular belief seems to be in her case, as in the Aztec children, that she is a specimen of a race, half human and half brute.

The girl is modest, playful in her disposition, pleased with playthings, like a child, and at times rather hard to manage from her obstinacy and impulsive character. She is quite intelligent, understands perfectly every thing said to her, can converse in English, and also in Spanish; she has a good ear for music, and can sing tolerably well; she can also sew remarkably well; she is very fond of ornament and dress. Her appearance is far less disgusting than the representations of her; the enormous growth of hair on the face, and the prominence of the lips from diseased gums, give her a brutish appearance. Her hair is long, very thick, black and straight, like that of the American Indian; the hair, of the same color and character, grows on the forehead quite to the eyebrows, varying from one half to an inch in length, having been partially cut off in the middle of the forehead: the eye-brows are very thick and shaggy, and the lashes remarkably long: the hair also grows along the sides and alœ of the nose, upper lip, cheeks and about the ears, which are large and with very large lobes: the chin is also well supplied with a black fine beard or goatee, two or three inches long: the arms are hairy for a

woman, though not for a man; on other parts of the body there can be said to be no unusual growth of hair. There is a great mammary development. I have measured her head carefully, and it does not differ much from the average of these races as given by Dr. S. G. Morton.

	Long. Diam.	Par. Diam.	Front. Diam.	Inter m'stoid arch.	Occip. Front arch.	Horizontal Periphery.
Ordinary	6·7 in.	6	4·9	14·6	13·1	20
Opate	6·3	5·5	4·2	13·5	13	20

These measurements are somewhat approximative, as the integuments over the skull are preternaturally thick; she has, therefore, a well-proportioned though small brain, and is capable of considerable cultivation. This head varies somewhat from that of an American Indian: there is no characteristic prominence of the vertex, no flatness of the occiput or forehead, no want of symmetry in the two sides: the shape of the cheeks and the complexion is hardly Indian. The space between the orbits is large, the eyes are very black and piercing; there is no obliquity to be noticed as in the Mongol. The nose is flat, quite unlike the aquiline nose of the Indian, and yet not like that of the Negro. The mouth is very large, and the lips prominent and rather thick; the gums are in a curious condition, being swelled all round so as to rise above and conceal the teeth; they are not sensitive, and so hard as to allow her to crack hard nuts with them; the growth in the upper jaw is chiefly hypertrophy of the bone, and in the lower jaw principally a disease of the gum resembling "vegetations." The molars, bicuspids, and canines are normal, though the latter are imbedded in the abnormal gum, while the back teeth are behind it; she is said never to have had incisors, but that must be an error, as she has the stump of one even now in the upper jaw, and there is no reason to believe that she had not the normal number; this condition of the gums might readily cause the loss of the exposed front teeth, while the back teeth might remain sound. She has a decided chin which would indicate her humanity if nothing else did. She has a well-formed arm, and a small symmetrical hand; she has also small feet. She is a perfect woman in every respect, performing all the functions of women regularly and naturally.

She is evidently human, and nothing but human; she is quite unlike the mixed African. Is she an American Indian? It may be here remarked that her complexion, soft skin, hair, and shape of the head, face, and nose, remind one more of an Asiatic than an American type; her disposition, too, is mild and playful, her manners gentle and communicative, differing from the sullen, taciturn, and forbidding ways of the Indian. It is well known that some authorities maintain that the California Indians are of Asiatic origin—Malays who have been thrown in some way on the American shore from the Pacific Islands. The notion also prevails among many of the tribes bordering on the Gulf of California (among the Ceris for instance), that they are of Asiatic origin. This girl seems either of Asiatic origin, or of Asiatic and American Indian mixed. She is no specimen of a degenerate race, but an exceptional specimen, such as occurs not unfrequently in all races. Hairy women have lived before her without any suspicion of brute paternity. The conformation

of her mouth, in so far as it is abnormal, is more likely the result of disease than a character of a tribe. The causes of these peculiarities must be sought for among those which modify the products of conception and impress various fancied or real animal or vegetable resemblances upon the fœtus in utero; and which, in some inexplicable way, seem to arrest or modify animal development.

THE HUMAN RETINA.

In a memoir read before the Academy of Sciences, September 26, 1854, by Kölliker and H. Muller, they announce some important investigations relative to the structure, the connection, and the probable function of the different parts of the retina. They describe the following layers: 1. Rods and cones. 2. Nucleiform bodies. 3. Gray substance. 4. Expansion of the optic nerve. 5. Limiting membrane. Passing over the last, it has been discovered by Kölliker that the expansion of the optic nerve is interrupted at the macula lutea, which exhibits no trace of nerve-fibers, while the nerve-cells form there a very thick layer of 9 to 12 superimposed rows. In other parts the termination of the nerve-fibers of the retina directly in the nerve-cells has been fully confirmed, the fibers becoming continuous with the processes, 1 to 6 in number, which these cells present, resembling entirely the prolongations of the ganglionic corpuscles of the brain and nervous ganglia. The nerve-fibers may, therefore, be said to originate from the nerve-cells. The cones (hitherto imperfectly described) are thicker and shorter than the rods, on the inner part of which they are placed; they present externally a prolongation resembling a short rod; they are pretty regularly set, and at the macula lutea, where the rods are entirely wanting, the cones are abundant and form a continuous layer. From the internal part of each cone and rod there proceeds a fiber which passes through all the layers of the retina, and becomes lost on the inner surface of the limiting membrane. These fibers, first observed by H. Muller in animals, are in relation with the nucleiform bodies; they have been named "fibres radiares," and are probably of great importance in regard to the functions of the retina.

From their observations the authors conclude that the nerve-fibers of the retina do not serve for the objective perception of light, because they are deficient at the macula lutea, where vision is acute, and because the optic nerve itself is insensible of luminous impressions. It is improbable that the nerve-cells, or nucleiform bodies which exist in several superimposed rows, can give rise to any very exact visual impression. The cones and rods remain, therefore, as the most likely parts to receive the impression of light, of which the Mosaic-like disposition would render the sensation as definite and exact as possible. The authors, however, have not completely demonstrated the connection by which such impressions could be transmitted to the fibers of the optic nerve; but they suppose that this communication takes place, 1st, by means of the radiary fibers, which connect the cones with the nucleiform bodies. 2d. By means of the processes of the nucleiform bodies, which becoming continuous with the external processes of the nerve-cells, would com-

plete the communication from the nucleiform bodies to the nerve-fibers of the retina. However this may be, the authors conclude that the nerve-cells are the organs for the direct sensation of light, either immediately or by the intervention of the cones, rods, and radiary fibers; that these cells form a true ganglion or nervous center, and that the optic nerve serves merely to transmit the sensations from the center to the organ of intelligence and consciousness.

OBSERVATIONS ON THE STRUCTURE OF HAIR.

Mr. Browne, of Philadelphia, well known for his researches and theories on the constitution of animal hair, has applied his theory to the question whether the people whose remains are found in the mounds are identical with the existing race of American Indians. His conclusion is, that they are, which he founds upon the identity of form between the horizontal sections of the hair of the former and that of hundreds of specimens of the latter.

Mr. Browne divides the hair of the human family into the cylindrical, the oval, and the eccentrically elliptical, as characterizes the various races. Mr. Browne has examined the hair of the mummy of a young American Indian, supposed to be a female of about ten years old, from Pachacarnack, Temple of the Sun, five leagues from Lima, South America. This cemetery has not been used since the Spanish conquest, previously to which (according to Herrera) it was kept sacred for the nobles and other dignitaries of Peru. The hair of this Indian, which is in good preservation, is *cylindrical*, diameter 1-364 of an inch. Mr. Browne has also examined eight other ancient specimens of Indian pile, and finds similar results.

On the other hand, he has submitted to the most critical investigation the hairs found upon the mummies of Egypt and Thebes, and has found them to be *oval*, without a solitary exception.

These observations of Mr. Browne bear upon the very interesting question in ethnology, as to the origin of the aboriginal inhabitants of America. Provided the hair theory be true, the favorite doctrine with many, that the Indians of this continent are descended from the Asiatics, must be false.

ON THE OVA OF THE SALMON.

A paper has been presented to the Royal (English) Society by Mr. Hogg, on the "External Membrane of the Unimpregnated and Impregnated Ova of the Salmon." Mr. Hogg commences by mentioning the opinions which several authors and physiologists hold with regard to the penetration, by the fecundating principle of the milt of the male salmon, the semen of the common frog, rabbit, and other animals, through pores or cells, or even through a cleft or aperture, in the exterior membrane or envelop of the ova of the females; and then showed that the numerous spermatic animalcules, or spermatozoa, which abound in the milt and liquor seminis of the males, constitute the sole fecundating agents. With a view of ascertaining, if possible, the existence of any pores or aperture in the external membrane of the ova of the salmon, as well the unimpregnated as the impregnated, Mr. Hogg magnified portions

of their membranes under a good microscope, but was not able to perceive any whatever, the membrane presenting a transparent plain tissue. He also examined some of the entire ova, contained in both phials, with a powerful lens, without detecting any cleft or orifice, the absence of which, indeed, confirms Mr. Newport's careful examination of the envelops of the ovum of the frog. Mr. Hogg concluded by stating that the latest discovery of this lamented physiologist, which he made known on the 18th April of last year proved that the spermatozoa do not reach the interior and yelk of the frog's ovum by any aperture in its envelop, but that they penetrate forcibly the very substance of the envelop wherever they may come accidentally into contact with it. This fact will also account for the non-appearance of any special pore, or cleft, or orifice, in the enveloping membrane of the ova of the salmon.

SARDINES IN CALIFORNIA.

Myriads of sardines abound along the whole southern coast of California. The bay of Monterey has especially become famous for its abundance of this small, but valuable fish. It is a matter of surprise that the taking and preparation of this fish, which enters so largely into the commerce of the world, has never been attended to as a source of revenue and profit there, to supply the home demand, instead of importing, as is now done, some 8,000 or 9,000 cases.—*Journal of the Society of Arts.*

CURIOUS HABIT OF A CALIFORNIA WOODPECKER.

Mr. John Cassin, in his beautiful work on the birds of California and Texas, notices a curious habit of a species of woodpecker from California, the *Melanerpes formicivorus*, of storing away a supply of food for the winter in holes made for the purpose in the bark of trees. He says: "In the autumn this species is busily engaged in digging small holes in the bark of the pines and oaks, to receive acorns, one of which is placed in each hole, and is so tightly fitted or driven in as to be with difficulty extracted. Thus the bark of a large pine, forty or fifty feet high, will present the appearance of being studded with brass nails, the heads only being visible. The acorns are thus stored in large quantities, and serve not only the woodpecker in the winter season, but are trespassed on by jays, mice, and squirrels.

ON THE BIRDS OF THE UPPER AMAZON.

At a recent meeting of the London Zoological Society, Mr. Gould exhibited to the meeting a portion of a collection of birds, formed by Mr. Hauxwell, in a district lying on the eastern side of the Peruvian Andes, in the neighborhood of the river Ucayali, one of the tributaries of the Upper Amazon. Mr. Gould observed that the exploration of this district had been one of the earliest objects of his own ambition, but that, until within the last few years, no naturalist had visited it. The splendid collection sent by Mr. Hauxwell, of which the birds exhibited formed a part, fully bore out the anticipations en-

tertained by Mr. Gould that, when explored, it would prove one of the richest and most interesting ornithological districts with which we are acquainted. Among the birds exhibited were some *Cotingas*, differing from the ordinary species found in the lower countries of Brazil, and remarkable from the splendor of their coloring, together with species of *Phœnicercus*, *Rhamphocelus*, etc., of the most dazzling brilliancy. As a contrast to these Mr. Gould exhibited a series of dull-colored birds (*Thamnophili*), also contained in the collection, and remarked that this striking difference in the coloration of birds inhabiting the same locality was due almost entirely to their different degrees of exposure to the sun's rays; the brilliantly-colored species being inhabitants of the edges of the forest, where they fly about among the highest branches of the trees, while the others form a group of short-winged insectivorous birds, which inhabit the low scrub in the heart of the dense humid jungle, where the sun's rays can rarely, if ever, penetrate. Mr. Gould also remarked that the colors of the more brilliant species from the banks of the Ucayali, a district situated toward the center of the South American continent, were far more splendid than those of the species which represented them in countries nearer to the sea; and from this circumstance he took occasion to observe that birds from the central parts of continents always possess more brilliant colors than those inhabiting insular or maritime situations. This rule applies even to birds of the same species—the tits of central Europe being far brighter in color than British specimens. Mr. Gould had observed a like difference between specimens of the same species inhabiting Van Diemen's Land and the Continent of Australia. He attributed this principally to the greater density and cloudiness of the atmosphere in islands and maritime countries; and in further illustration of the influence of light upon color, he remarked that the dyers of England can never produce tints equal in brilliancy to those obtained by their continental rivals, and that they never attempt to dye scarlet in cloudy weather.

NEW GENERIC TYPE OF FISHES.

At a meeting of the California Academy, February 26, 1855, Dr. Ayres presented a specimen of a new generic type among fishes, which has been named *anarrhichthys occellatus* Ayres. It has a very long body in proportion to its thickness, being nineteen times the length of its greatest thickness, thus resembling the eel, but in other respects it is very different. It is very rare; only two specimens of it have yet been seen.

GEOGRAPHY AND ANTIQUITIES.

EXPLORATIONS IN CENTRAL AFRICA.

THE present age, says the New York *Tribune*, is emphatically the age of geographical discovery. At no period since the days of Columbus and Cortez has the thirst for exploration been more active and universal than now. One by one the outposts of barbarism are stormed and carried; advanced parallels are thrown up, and the besieging lines of knowledge, which, when once established, can never be retaken, are gradually closing around the yet unconquered mysteries of the globe. Within the last twenty-five years all the principal features of the geography of our own vast interior regions have been accurately determined; the great fields of Central Asia have been traversed in various directions, from Bokhara and the Oxus to the Chinese Wall; the half-known river-systems of South America have been explored and surveyed; the icy continent around the Southern Pole has been discovered; the North-western Passage—the ignus-fatuus of nearly two centuries—is at last found; the Dead Sea is stripped of its fabulous terrors, the course of the Niger is no longer a myth, and the sublime secret of the Nile is almost wrested from his keeping. The Mountains of the Moon, sought for through two thousand years, have been beheld by a Caucasian eye; an English steamer has ascended the Chadda to the frontiers of the great Kingdom of Bornou; Leichardt and Sturt have penetrated the wilderness of Australia; the Russians have descended from Irkoutsk to the mouth of the Amoor; the antiquated walls of Chinese prejudice have been cracked and are fast tumbling down, and the canvas screens which surround Japan have been cut by the sharp edge of American enterprise. Such are the principal results of modern exploration. What quarter of a century, since the form of the earth and the boundaries of its land and water were known, can exhibit such a list of achievements?

Of all the more recent schemes of exploration none approaches in interest and importance the expedition to Central Africa, which has now been carried on for nearly six years under the combined patronage of the English and Prussian governments. Notices of the progress of this expedition have from time to time been given to the public. Piece by piece, with long intervals between, the story of its difficulties, its dangers, its defeats, and successes has been transmitted across the Sahara, from whose further bourn so few

travelers return, and for a long time its final fate seemed to hang by a thread which the slightest chance might snap. One after one the intrepid explorers sickened and died, and when, a year ago, it was reported that Dr. Barth, the last remaining member of the original company, had been murdered in Timbuctoo, the world was almost ready to believe that the Central African secret was but a lure to tempt brave men to their destruction.

But the truth is, this expedition seems destined to become the turning point in the history of African exploration. After much disaster, it is at last successful beyond all expectation. On the morning of the 8th of September Dr. Barth landed at Marseilles, precisely five years and nine months after his departure from that port in 1849, on his way to Tripoli to join Mr. Richardson, who had command of the expedition. The intervening period contains a history of greater peril and privation, greater hazards, and more wonderful escapes, greater disappointments and more complete triumphs, than has ever fallen to the lot of any African traveler. As the return of Dr. Barth may be looked upon as the termination of the original expedition, notwithstanding Dr. Vogel still remains to attempt further discoveries, we proceed to give a brief outline of what it has accomplished.

The undertaking originated with Mr. James Richardson, who had previously explored the northern part of the Sahara. In the summer of 1849 he received a commission from the British Government to visit Central Africa on a political and commercial mission. Drs. Barth and Overweg, who were highly recommended by Humboldt, Ritter, and Encke, volunteered to accompany him, the former as antiquarian and philologist, the latter as naturalist, on condition that the British Government should defray their expenses. Their offer was accepted, and an appropriation of $4,000 made for them, in addition to which they received $3,000 from the Geographical Society of Berlin, the King of Prussia and other sources. The explorers met at Tripoli, where they were delayed some time for the purpose of having a boat constructed for the navigation of Lake Tsad. Finally, on the 30th of March, 1850, the party started, comprising a caravan of forty camels, with which they joined the great semi-annual caravan to Bornou.

On the 6th of May they reached Mourzuk, the capital of Fezzan, where they were obliged to await the arrival of a chief of the Tuarick tribe, who was to escort them to Ghat. Instead of following the caravan route from Mourzuk to Central Africa by way of Bilma, they determined to proceed from Ghat in a south western direction through the unknown kingdom of Aïr or Ashen, which had never been visited by Europeans. Dr. Barth, in attempting to explore a group of hills near Ghat, called *Kasr Djenovn*, or the Palace of Demons, lost his way and remained twenty-eight hours in the desert without water. His tortures were so great that he opened a vein and drank his own blood. The Tuaricks considered his preservation miraculous, as they had never known any one to survive more than twelve hours' deprivation of water.

Leaving Ghat on the 25th of July they continued their journey southward through unexplored deserts, and in a month reached the frontiers of Aïr. Here, after being attacked by Tuaricks, threatened with death by the fanatical

Moslem priests, who were determined that no infidels should pass through their country, and exposed to demands for tribute from En-noor, the sultan of the kingdom, they were obliged to remain for more than three months awaiting a safe opportunity to proceed further. During this time Dr. Barth made a journey to Agadez, the capital of Aïr, a city containing 8,000 inhabitants, situated in a rich and beautiful valley. The entire kingdom contains a population of 70,000. The climate is healthy for Europeans. The inhabitants appear to be a branch of the Tuarick or desert tribe mingled with the race of Soudan. They are tall and finely formed, and some of them are quite European in features and complexion.

After a period of great uncertainty and anxiety, the travelers finally won the good-will of Sultan En-noor, who escorted them over the remaining portions of the desert into Soudan, on the borders of which they arrived on the 1st of January, 1851. At the village of Tagelal, in the country of Damergou, they separated, and, in order to explore as much of Soudan as possible, took separate routes, making Kuka their place of rendezvous. Mr. Richardson took the direct road, by way of Zinder, the capital of Damergou, while Dr. Barth set out for Kashna and Kano. Mr. Richardson remained nearly a month at Zinder, and continued his journey, encountering no difficulties on the way until the close of February, when he fell sick at a village called Ungurutua, only six days' journey from Kuka. From his journal, which has since been published, he seems to have suffered severely from the heat and the fatigue of travel. He never rallied, but gradually became weaker, and died on the 4th of March. Dr. Barth did not hear of his death until the 25th of that month. He immediately hastened to Ungurutua, and succeeded in saving the papers of the lost leader, which were forwarded to England, and have since been published.

Dr. Barth, on whom the management of the expedition now devolved, hastened on to Kuka, where he arrived on the 2d of April. He was very hospitably received by the Sultan, and received a loan of $100 from the vizier, without which aid he would have been greatly embarrassed, as the expedition was completely disorganized and its means almost exhausted. Dr. Overweg, who had undertaken to explore Gaber and Mariadi, two independent pagan countries, in the direction of Sackatoo, was kindly received by the natives, who are a cross between the Tuaricks and the negro races. He spent two months in their countries and obtained much valuable information respecting them. He proceeded to Kuka by way of Zinder, and finally rejoined Dr. Barth on the 7th of May.

The two travelers immediately began to prepare for further explorations. Dr. Barth, while on his way from Kano to Kuka, received accounts of a large kingdom to the south, called Adamawa, which was said to be the most beautiful portion of Central Africa. After much hesitation, the Sultan of Bornou gave him a letter to Adamawa, and furnished him with a captain and three men as escort. He started on the 29th of May, and traveled southward for three weeks over broad, fertile plains, and through forests infested with lions and elephants. On entering the kingdom of Adamawa he found the country very thickly populated, the inhabitants possessing large herds of cattle. The

cultivation of the soil is carried on by slaves, who greatly outnumber the free inhabitants; there was no person so poor as to have less than three or four. On the 18th of June Dr. Barth discovered the great river Benuë, at its junction with an affluent called the Faro. The namo signifies the "Mother of Waters," and the stream is half a mile wide, and nine feet deep in the channel. Dr. Barth conjectured that this river was in reality the Chadda, the eastern arm of the Niger—an opinion which has since been confirmed by actual exploration.

On the 22d of June he reached Yola, the capital of Adamawa, a town two miles and a half in length by one and a half in breadth. It is situated on a level plain, at the foot of the mountain Alantika, which rises to the height of 10,000 feet. The sultan, whose name was Mohammed Loel, having taken offense at some expressions in the letter of the Sultan of Bornou, Dr. Barth was ordered to leave the place, after a stay of three days. He returned by the same route, and reached Kuka on the 22d of July. During his absence, Dr. Overweg launched the boat of the expedition on the waters of Lake Tsad, and employed five weeks in exploring the islands and shores. He found it to be about 80 miles in breadth, but very shallow, the soundings ranging between 8 and 15 feet. The greater portion of the lake is occupied by a vast labyrinth of small islands, inhabited by a tribe called the Biddumas, who treated the explorer with the greatest kindness.

After the return of Dr. Barth, the travelers planned an excursion to Kanem and Borgon—an unexplored country lying to the north-east of Lake Tsad, and extending midway to Egypt. They obtained the protection of an Arab tribe, and had almost reached the capital of Kanem, when the Tibboos fell upon the Arabs and defeated them—obliging the travelers to retreat in haste. They returned to Kuka after two months' absence, and found the sultan preparing to send an army to subjugate Mandara, a country lying to the south-east of Bornou. They immediately resolved to take part in the campaign, which lasted from the 25th of November to the 1st of February, 1852. The army, consisting of 20,000 men, penetrated to the distance of two hundred miles in a south-eastern direction, and returned with a booty of 5,000 slaves and 10,000 head of cattle. The country was very level, and abounded with marshes.

The travelers immediately set about planning other explorations with an energy as admirable as it is rare. Dr. Barth left Kuka toward the end of March, and, after great difficulties and dangers, succeeded in reaching Masena, the capital of Baghirmi, a powerful kingdom to the east of Bornou, which had never before been visited by a European. He was not able to penetrate further to the East, as had been his intention, but was obliged to return to Kuka, where he arrived on the 20th of August. Dr. Overweg attempted to penetrate the great Fellatah kingdom of Yakoba, lying on the River Benuë, but was driven away from its frontier, and reached Kuka after an absence of two months. His constitution, which was naturally ill-adapted to endure the mid-African heats, began to give way, and after several attacks of weakness and fever, he finally met the fate of Richardson. He died on the 27th of September, 1852, in the arms of Dr. Barth, who buried him near the village of

Maduari, on the shores of Lake Tsad, which he was the first European to navigate.

Meantime letters and funds had arrived from England, and Dr. Barth, finding his own health unimpaired, determined to carry on the undertaking single-handed, regardless of the perils and privations that awaited him. He made preparations to leave for Sackatoo and Timbuctoo, but first took the precaution of forwarding all his papers to England. He finally left Kuka on the 25th of November, 1852, reached Sackatoo in April, 1853, and entered the famous city of Timbuctoo on the 7th of September. After this nothing was heard of him for a long time, and the most serious apprehensions were felt concerning him. Word at last reached Tripoli, by way of Bornou, that he had fallen a victim to the enmity of the chief of the desert tribes around Timbuctoo, who had sworn that he should never leave the city alive.

Previous to leaving Kuka he had written to the British Government requesting that another coadjutor might be sent out, to supply the loss of Dr. Overweg. Dr. Edward Vogel, an assistant of Mr. Hind, the astronomer, volunteered his services, which were accepted, and he was also permitted to take two volunteers from the corps of sappers and miners. This new party left Tripoli on the 28th of June, 1853, accompanied by Mr. Warrington, son of the English consul at that place. They reached Mourzuk on the 8th of August, and were obliged to remain there until the 13th of October, when they started for Boruou with a caravan of 70 camels. The march across the Sahara was very rapid and fortunate, and in December they arrived safely at Kuka. The next news which reached England, and which immediately followed the account of the murder of Dr. Barth, was the death of Mr. Warrington and the dangerous illness of Dr. Vogel. The Expedition seemed to be fated, in every way.

After some months of painful uncertainty, came the joyful intelligence that Dr. Barth was still alive and had left Timbuctoo, after a stay of nearly a year. The report of his death had been invented by the Vizier of Bornou, who coveted the supplies belonging to the Expedition, and who would no doubt have taken measures to have the story confirmed, for the sake of securing the plunder, had he not been deposed in consequence of a political revolution in Bornou. What happened to Dr. Barth during his stay at Timbuctoo has not yet been made known, but it is said that he owed his safety to the friendship of the powerful Sultan of Houssa. He succeeded in exploring the whole middle course of the Kowara (Niger), which no one but the lamented Park, whose journals perished with him, ever accomplished. In his journeyings in those regions, he discovered two large kingdoms, Gando and Hamd-Allahi, the very names of which were before unknown. He was treated with the greatest reverence by the inhabitants, who bestowed upon him the name of "Modibo," and seemed to consider him as a demi-god. He reached Kano, on his return, on the 17th of October last, and on the 1st of December met Dr. Vogel, his associate—the first white man he had seen for more than two years! He probably spent the winter in Kuka, and started in March or April on his return to Europe, as we find that he reached Mourzuk on the 20th of July. Dr. Barth is not yet thirty-five years of age, and with the boundless

energy of an explorer, intends returning to Central Africa. He stands now, indisputably, at the head of all African travelers.

The discovery of the River Benuë led to another expedition to the Niger last winter, under the direction of Mr. Macgregor Laird, who defrayed the greater part of the expense. The steamer *Pleiad* ascended the Niger to the Chadda, entered that river, and extended her voyage 250 miles beyond the point reached by Allen and Oldfield in 1833. This voyage established the fact that the Chadda and Benuë are one and the same river—a river which is navigable for steamboats to the very borders of Bornou, for six months in the year. Here is a highway for commerce into the very heart of Africa. A remarkable feature of the voyage was, that not one of all who engaged in it died, a result which was entirely owing to careful sanitary regulations.

Dr. Vogel, after his recovery, imitated Barth and Overweg in accompanying the army of Bornou on its annual foray to the south-east in search of slaves and cattle. He went about ninety miles beyond the furthest point reached by his predecessors, and discovered a large lake and two or three rivers, the existence of which was not previously known. The last accounts from Central Africa state that he has succeeded in reaching Yakaba, the capital of the great Fallatah kingdom, which Dr. Overweg endeavored in vain to penetrate. He designs going thence into Adamawa, where he will ascend the great mountain Alantika, and push his way further, if possible, into the countries of Tibati and Baya, lying beyond. He will also endeavor to penetrate through Baghirmi into the unknown and powerful kingdom of Wæday. It is almost too much to expect that Dr. Vogel will be successful in all these daring designs, but he has youth, enthusiasm, and intelligence on his side, and there are few difficulties which these three auxiliaries will not overcome.

We learn, also, from South Africa, that Mr. C. J. Anderson has succeeded in penetrating from Walwich Bay, on the western coast, to the great Lake N'gami, discovered four years ago by Dr. Livingston. He there heard of the existence of a large town called Liberbe, nineteen days' journey to the north-east, which was said to be a great place of trade. Dr. Livingston, who made his way northward from the Cape of Good Hope to latitude 10° south, came down unexpectedly on the Portuguese town of Loanda last winter, and then went back into the wilderness, will probably come to light again in another year, and we shall then have the result of the most important exploration of the southern half of the African continent which has ever been made. There now remains but a belt of fifteen degrees of latitude to be traversed to enable the explorers of the north to shake hands with the explorers of the south. In less than twenty years their trails will touch, and the secret of Africa be won!

ON THE CUNEIFORM INSCRIPTIONS OF ASSYRIA AND BABYLONIA.

The following is an abstract of a paper on the above subject read before the British Association by Colonel Rawlinson, well known for his Asiatic researches. He began by saying he feared the vastness, as well as to a great extent the novelty, of the subject would prevent him doing it any thing like

justice, in the very limited time he had at his disposal. The excavations which had been carried on in Assyria and Babylonia, had been continued through six or seven years—they had ranged over tracts of country 1,000 miles in extent—the marbles excavated would be sufficient to load three or four ships, and the historical information contained in them would exceed ten thousand volumes in clay. Of course, in dealing with such a subject he could only select a portion of it—and even of that he could only communicate the heads. The part to which he wished to direct their attention was the Cuneiform Inscriptions. This phrase merely signified the wedge-shaped form of writing, and was not employed in any particular language or by one particular nation. The cuneiform system of letters was a species of picture-writing, invented, not by the Semitic inhabitants of Babylon, but by those who preceded them. This writing was, however, reduced by the Semitic race to letters, and adapted to the articulation of their language. Their mode of writing consisted of several elements. There was the ideographic, or picture-writing, and the phonetic, which was equivalent to the alphabet of their language. He had been fortunately able to obtain among the ruins of Nineveh a tablet which actually exhibited the several developments of this system of writing into a regular alphabet. The Cuneiform Inscriptions were divided into three branches—Persian, Scythic, and Assyrian;—and it was on the third of these that he wished to say a few words. He then proceeded to explain how the decipherment of these inscriptions had been obtained. About twenty years ago his attention had been directed to a series of inscriptions in cuneiform characters on a rock at Behistún, near Kermaixhah. The tablet was divided into three compartments, giving three different versions of the same inscription, and on the simplest of these, the Persian, he set to work, and found by comparing it with the two others that they corresponded, with the exception of two or three groups, from which, on further investigation, he made out—Hystaspes, Darius, and Xerxes. By means of these proper names he obtained an insight into the Persian alphabet, and by analyzing the names of the ancestors of Darius and Hystaspes, and obtaining a list of the tributary provinces of Persia he managed to form the alphabet. This was, however, but the first step; the great object being to decipher the Assyrian inscription, and this could only be done by comparing it with the Persian. The tablet was situated on the face of the rock, 500 feet from the ground, with a precipice above it of 1,200 feet, and, in order to reach it, it was necessary to stand on the top rung of a ladder placed almost perpendicular. Nor was this all, for there was still the Babylonian to be copied, and it was engraved on the overhanging ledge of rock, which there was no means of reaching but by fastening tent-pegs into the rock, hanging a rope from one to the other, and while thus swinging in mid-air, copying the inscription. An insight into the system of writing being thus obtained, the fortunate discovery of the ruins of Nineveh furnished a great mass of documents to which it might be applied. Wherever they had found tumuli, or any appearance of a ruin, trenches were sunk, galleries opened, and in almost every case they came upon the remains of inscribed tablets. Whether it was the king who wished to issue a bulletin, or a shopkeeper to make up his accounts, the same process had to be gone

through of stamping it on clay tablets. The decipherment of these inscriptions led to important results in an ethnological point of view, both as indicating the race to which the writers belonged, and affording important information with reference to the habitat of races and their migrations. Among the many points which they were now enabled satisfactorily to settle, he alluded to the connection between the Turanian and Hamic families, and to the occupation of Western Asia by the Scythic, and not the Semitic race. He also mentioned that from the inscriptions he believed it could be shown that the Queen of Sheba came from Idumea. As to the advantages conferred on geography by these discoveries, he would not attempt to give in detail the ramifications of geographical knowledge which had been thus obtained. He would proceed to the most interesting and important branch of the subject, the historical. An erroneous impression was at one time in circulation that the information obtained from the inscriptions was adverse to Scripture. But so much was it the reverse of this, that if they were to draw up a scheme of chronology from the inscriptions, without having seen the statements of the Scriptures, they would find it coincide on every important point. The excavations at Chaldea furnished them with inscriptions showing the names of the kings, their parentage, the gods they worshiped, the temples they built, the cities they founded, and many other particulars of their reign. He then mentioned some circumstances with reference to the mound at Birs-Nimroud, which he had recently uncovered, and which he found laid out in the form of seven terraces. These were arranged in the order in which the Chaldeans or Sabeans supposed the planetary spheres were arranged, and each terrace being painted in different colors, in order to represent its respective planet. Another curious circumstance with reference to this excavation was the discovery of the documents inclosed in this temple. From the appearance of the place, he was enabled at once to say in what part they were placed, and on opening the wall at the place he indicated, his workmen found two fine cylinders. He also mentioned another small ivory cylinder which he had discovered, and round which were engraved mathematical figures, so small that they could hardly be seen with the naked eye, and which could not have been engraved without the aid of a very strong lens. In concluding, he said that before the British Association met next year, he hoped to be able to bring before them the decipherment of several highly important inscriptions.

DR. KANE'S ARCTIC EXPEDITION.

The return of Dr. Kane's Arctic Expedition may be said to close the eventful history of modern Arctic exploration, commenced by the dispatch of Sir John Franklin's Expedition in 1845.

The expedition of Dr. Kane sailed from New York on the 21st of May, 1853. It consisted of the brig "Advance," which carried seventeen persons, including the officers, and provisions for three years. The ostensible object was to search for Sir John Franklin by a new route along the west coast of Greenland, passing through Smith's Sound, and, if possible, into a Polar Sea, which was supposed to exist to the north. Great success attended the Ex-

pedition during the first summer. The party reached the headland of Smith's Sound as early as the 6th of August, 1853, when further progress became difficult on account of the great accumulation of ice. The vessel was, however, warped through the pack, and the Expedition finally gained the northern face of Greenland, at a point never before reached. Here the ice froze around the vessel, and compelled them to seek a winter asylum, in which they experienced a degree of cold much below any previous registration. Whisky froze in November, and for four months in the year the mercury was solid daily. In the ensuing spring the search was commenced, Dr. Kane heading a party in March, along the north coast of Greenland, which was followed until progress became arrested by a stupendous glacier. This mass of ice rose in lofty grandeur to a height of 500 feet abutting into the sea. It, undoubtedly, is the only obstacle to the insularity of Greenland, or in other words, the only barrier between Greenland and the Atlantic. It is, however, an effectual barrier to all future explorations. This glacier, in spite of the difficulties of falling bergs, was followed out to sea, the party rafting themselves across open water spaces upon masses of ice. In this way they succeeded in traveling eighty miles along its base, and traced it into a new northern land.

The explorations of the Expedition, as described by Dr. Kane in a letter to Mr. Peabody of London, "embraced the entire shores of Smith's Sound, and a new channel expanding from its north eastern curve into an open Polar Sea. This great watercourse embraced an area of 3,000 square miles entirely free from ice. It washed a bold and mountainous coast, which has been charted as high as latitude 82° 30′. Smith's Sound terminates in an extensive bay, which bears your name, and the coast of Greenland, after being followed until it faces the north, was found cemented to the coast of America by a stupendous glacier which checked our further progress toward the Atlantic."

The land attached to Greenland by ice has been named "Washington," and that to the north and west of the channel leading out of Smith's Sound, "Grinnel." The second winter was one of great suffering—scurvy attacked the party, and at one time every man of the Expedition, except Dr. Kane and Mr. Bonsell were laid up by this disease. To aggravate their misfortunes there was a deficiency of fuel, and they were even obliged to adopt the habits of the Esquimaux and live upon raw walrus flesh. As it was impossible to disengage the ship from her ice-bound position, it was resolved to abandon her, and on the 17th of May, 1855, the party commenced their journey to the south in boats and sledges, and finally arrived on the 6th of August at the North Danish settlements in Greenland, having traveled 1,300 miles.

ASTRONOMY AND METEOROLOGY.

NEW PLANETS DISCOVERED DURING THE YEAR 1855.

The number of planetary bodies belonging to the solar system has been increased during the year 1855 by the discovery of four new asteroids. The whole number at the commencement of the year was thirty-three, the present number thirty-seven.

The thirty-fourth asteroid was discovered by Chacornac, of the Paris Observatory, on the night of the 6th of April. It appears as a star of the eleventh magnitude, and has received the name of Circe.

The thirty-fifth member of the asteroidal group was discovered on the 19th of April, by M. Luther, of Bilk, Germany. It has received the name of Leucothea.

The thirty-sixth asteroid was discovered by M. Goldschmidt, of Paris, on the 4th of October. It has received the name of Atalanta.

The thirty-seventh asteroid was discovered by M. Luther, of Bilk, on the 5th of October, and has received the name of Fides.

COMETS OF 1855.

The first comet of 1855 was discovered by M. Dieu, of the Paris Observatory.

The second was seen by Dr. Schweitzer, of Moscow, on the 11th of April.

The third comet was discovered at Florence, June 3d, by Dr. Donati. It was also seen the next day at Göttingen and at Paris. Dr. Donati was unable to detect any nucleus or tail, and estimated it as fainter than the nebulæ in Hercules.

Meteoric Appearances of 1855.—The periodical visitation of meteors occurred during the past year much as usual. The observations at New Haven, on the night of August 9th, as recorded by Mr. E. C. Herrick, were 385; August 10th, 290; 11th, 95; 12th, 36. About four fifths of those observed were conformable to the usual apparent radiant, or point of divergence, near the cluster in the sword-handle of Perseus.

ON THE ZODIACAL LIGHT.

The following is a paper on the Zodiacal Light, read before the American Association, Providence Meeting, by Reverend George Jones, U. S. N.:

Only some vague notices of the zodiacal light occur in ancient authors before it is distinctly and briefly mentioned by Chauldry, in 1661. It was first carefully observed by Cassini, an Italian by birth, at the Observatory of Paris. He thought it an emanation of the sun. His associate, Tacio, thought it a ring around the sun. Miran, in 1731, thought it an atmosphere connected with the sun. In all subsequent speculations no new observations after Cassini's were used till 1832. In 1844 Biot observed that the nodes of the zodiacal light did coincide with those of the earth, and suggested that it might be more local than had been supposed. He found that it gave much more heat than the tail of a comet did. No observations had been made previous to those of Mr. Jones except in northern latitudes. These were made at sea on a voyage to China. The zodiacal light appears best when it is on the ecliptic. When at the summer solstice and on the tropic of Capricorn the zodiacal light was visible from 11 to 1 in both horizons at once with their apices approaching each other. In the center of the zodiacal light is a condensed part with a boundary of its own. On this voyage, January 31, 1854, at Loochoo, he first noticed the pulsations of intensity in the space of a minute or two that it exhibits on some occasions. He made 331 sets of observations. He found that if by the revolution of the earth he receded from the ecliptic, the zodiacal light moved a little in the same direction, and vice versâ.

Mr. Jones then stated that the following facts he had noticed could be explained by one supposition, viz., that of a nebulous ring surrounding the earth; the following are the results of his observations:

1. This light can not be from any body involving us in its matter, else we could not get boundaries to it any more than we could to a mass of fog or a column of smoke in which we were involved. We must be apart from it in order to get bounds.

2. It can not be from a planetary nebulous body revolving around the sun, but must be from a nebulous ring; for it is to be seen every morning and evening in the year, when the moon or clouds do not interfere, which could not be the case were it any thing else than an unbroken ring.

3. If a ring, with the sun for its center, it can not be within the orbit of our globe, for then it could not be seen simultaneously over the eastern and western horizon at midnight, the spectator's horizon then extending far above it on either side; nor could its vertex ever be in the spectator's zenith, or indeed any great distance above his horizon, which is contrary to facts.

4. Is it a solar ring extending beyond the earth? On this subject I must refer to the data afforded by these observations, for it is only from facts that we are able to argue in the case. Any one examining these data will see, I think, that the *lateral* changes from hour to hour in the boundaries of the zodiacal light especially toward the horizon, could not have taken place in a ring so distant as a solar ring would have been at the point where

reached by the horizon. There is also in almost all these lateral changes a striking coincidence between the character and extent of the change and the change of place of the spectator with regard to the ecliptic. If I was on the southern side of the ecliptic, though my left itself might be north, the lateral changes were in the southern side of the zodiacal light; if I was on the north of the ecliptic these lateral changes were on the northern side of the zodiacal light. If, in the course of four or five hours, the earth's rotation carried me from the southern to the northern side of the ecliptic or the opposite, the zodiacal light changed with me, its lateral boundaries shaping themselves according to my change of place. This was not always the case, but it was the general fact. When I was far in southern latitudes the greater mass of the zodiacal light, instead of being on the northern side of the ecliptic as here, had shifted over to the south; and as we came from Rio to New York, as rapidly as steam could carry us, the mass of light came with us to the north once more; still, however, in its varying positions having a reference to my position with regard to the ecliptic. I ask, supposing that the zodiacal light is from a solar ring, which would make the base of its light at its first and last appearance, nearly or quite 180,000,000 miles off, would that light at its base show such changes as it actually does in half an hour or an hour, when the spectator's place on the earth has been so slightly changed? I have taken a few of my observations, and have submitted them to calculation, not making much of a selection, for almost every observation in the book would give similar results.

On September 4, 1854, lat. 22° 18′ N., last morning observation at 4h. 30m.: sun rose at 5h. 48m.*; angle between the sun and my horizon consequently 19° 30′; supposing a ring around the sun reaching to the earth, my horizon would then cut it at a distance of 179,000,000 of miles. From 3h. 30m. to 4h. 30m., the lateral change in the zodiacal light boundaries at the horizon was 4°, or 16,000,000 of miles, while my own lateral change on the globe with reference to the ecliptic in that time had been but 240 miles. Query, could any amount of change of the spectator on our globe have produced that lateral change of 16,000,000 of miles at the base of the zodiacal light, 179,000,000 of miles distance?

January 30, 1851, in the morning, lat. 26° 10′ N., my last observation at 5 o'clock: sun rose at 6h. 50m.; on the former supposition, distance of the base of zodiacal light at 5h. 168,000,000 of miles; my lateral change on the globe from 4,000 to 5,320 miles; the lateral change in the zodiacal light if round the sun 35,000,000 miles.

November 20, lat. 36° 17′ N., morning, last observation at 5: sun rose at 6h. 46m.; base of zodiacal light at 5, 170,000,000 miles; my own lateral change toward the ecliptic from 4 to 5, 240 miles; lateral change in the zodiacal light at its base 16,300,000 miles.

January 9, 1855, evening lat. 8° 47′ N.: sun set 5h. 52m.; first observation at 7h. 20m., next at 8 o'clock; base of zodiacal light at first observation distant 176,000,000 miles; lateral change there in 40′ 7,684,000 miles; my own lateral change on the globe, 180 miles.

* I use apparent time.

March 16, 1855, evening, lat. 22° 55′ S., sunset 6h. 12m.; first observation at 7h. 30m.; next at 8; next at 8h. 30m. Rise of zodiacal light at 7h. 30m. distant 176,000,000 miles; lateral change in its light in half an hour 60, in an hour 135 miles.

These figures, I wish to say are the result in part of inspection or measurement on the chart; but they are sufficiently near for our use; and I put the query whether a solar ring can be supposed to meet the data of the case? An earth-ring will do it; that is, a nebulous ring around the earth will readily allow such lateral changes to be produced by such a change of the spectator's place.

But there is another view of this subject which may be considered still more conclusive against such a solar ring. Take cases which very often occur when the ecliptic is somewhere toward a right angle to the horizon, and circumstances therefore favorable for a good display of the zodiacal light. Say it is morning, an hour and a half before sunrise. The base of this light will be exceedingly brilliant—as much so almost as if the sun were just going to rise—while the vertex of the light overhead will be so dim as scarcely to be made out. Yet on the supposition of a solar ring reaching beyond the earth, the base of that light must be 180,000,000 of miles from us, and the vertex comparatively only a very short distance, while also the whole circuit of the ring is equally illuminated by the sun, and those portions near our zenith, as far as I can judge, also more favorably situated for reflecting his light than those portions at the base. We can scarcely imagine such a state of things.

Believing that this query must be answered in the negative, I am driven to the only alternative of *a nebulous ring around the earth*. The moon's zodiacal light seems also to show that matter lies within the orbit of the moon. I should judge from my observations that a cross section of this ring would be pear shaped, allowing no inward curves to the pair; that its more condensed or central portion is, as far as it shows itself to our eye, about 30° wide, while the more diffuse will make an angle to the eye of 100°. It appears to lie in general along the ecliptic, except in December and June, when observations of several successive nights in both 1853 and 1854 seemed to indicate a crossing of the ecliptic line at an angle of 5° to 8°; and perhaps, also, in September and March, a similar crossing in an opposite direction. We must speak, however, with great distrust of its width, for we have only its reflection in the night, as its journeyings over the eye change its place with regard to the ring itself, and thus bring different portions of its curved surface in a position to produce reflection cognizant by the eye. Still, I think the dimensions given above are near the truth.

I do not come here, however, as the advocate of a theory, but to give you the possession of facts. And the facts which I present are but meager compared with what we need. I hope, if they do nothing more, that they will increase the number of observers on this interesting subject; for it is not only interesting in itself, but one of the most striking things about it is that it is *suggestive*. It leads the mind far beyond itself. We may well query—if the zodiacal light comes from a nebulous ring around our earth and within the orbit of the moon, may not the shooting stars and even the aerolites have

their origin there? Observations, I think, show that there is a constant commotion within the ring itself; may not the nebulous matter, half agglomerated here and there, be shot by these commotions beyond its sphere, and, caught by the attraction of the earth, be drawn down till, striking our atmosphere, they glance in any casual direction, and taking fire become consumed, thus giving us the shooting stars? And may not this nebulous matter, still further solidified and with a same fate, afford us the aerolites? For if such matter could have once afforded us our moon, it may easily afford bodies such as aerolites are found to be. What is nebulous matter? My observations throw no light upon the subject. It is very transparent, for I had no difficulty in seeing stars of the sixth magnitude through its most effulgent, and therefore densest portions. But transparency does not argue tenacity as a matter of course; for rock crystal and the diamond are the most transparent, while they are the densest and hardest of all bodies. But of whatever composed, I do not suppose the ring of the zodiacal light to be composite, for its internal disturbances are opposed to this. But with our present knowledge, such reasonings can not satisfy us: they only beckon us on to be searchers and further collectors of facts.

Professor Peirce fully concurred with Mr. Jones in his theory, and if this theory had been the first proposed no second would ever have been entertained. His only objection had been that one satellite could never maintain a ring, and he still is of that belief, but is convinced that it has many other satellites too small to be seen, but that these satellites furnish the meteors which fall to the earth. As to their distance, he thinks that some may be within the ring and some beyond it.

Professor Alexander drew from the fact that the apices of the zodiacal light when both were visible were 35° apart, that the diameter of the earth's ring was 25,000 miles.

Professor Silliman, Sen., recounted the history of the Weston meteor. Immense masses have fallen. Now all of these must have a common origin, for they have a common chemical character. They must fall every few months on land or ocean. The height at which the Weston meteor exploded was supposed to be about 16 miles and its diameter about 1,300 feet. But little of it was found—where has the rest gone? He concluded that these masses revolve quite low.

Professor J. Lawrence Smith was certain that they were fragments of some body belonging to our own terrestrial system, but not to the earth. The questions of velocity and size are of the highest importance. They generally strike with the velocity of a cannon ball, although they have been supposed to enter the atmosphere with a velocity of about eighteen miles per second. As to their size: After the explosion of the Weston meteor, if any fragment went over it would have been visible many minutes after the explosion. He thinks the diameter over estimated, and that the pieces picked up were all. He made an experiment. He illuminated a little piece of charcoal, so that at the distance of half a mile, it showed an illuminated *disk* three times as large as the moon. Trigonometry would have made that point of charcoal 800 feet

in diameter instead of one eighteenth of an inch. He thought the Weston meteorite was several feet in diameter.

Professor Gould thought that Mr. Jones's observations threw more light on the nature of the zodiacal light than all before him. He added that if, instead of a ring, the zodiacal light were but an extension of the earth's atmosphere, it might not need planets to sustain it.

Professor Hackley thought that if the extent of the zodiacal light varied, the fact of their being 35° apart would throw no light on the question of the size.

ON CERTAIN ANOMALIES PRESENTED BY THE BINARY STAR, 70 OPHIUCHI, BY CAPTAIN W. S. JACOB.

This pair has been long known to astronomers as a binary system, but the exact orbit is yet in doubt, although nearly a whole revolution has been completed since it was first observed by Sir W. Herschel in 1779. All the orbits that have been computed fail at certain points in representing the observed positions, and those which best represent the angles fail entirely as regards the distances. The most remarkable point is, that even in those orbits which agree best with observation, the errors in the angles assume a *periodical* form, retaining the same sign through a considerable space of time. An orbit has been computed with a period of 93 years, in which the errors are + from 1820 to 1823 — with one exception from 1823 to 1830, doubtful in 1830 to 1832, and from 1833 to 1842 all +, after which they continue for the most part —. This sort of error must depend upon some law; it *might* arise from a change in the law of gravitation, but may be accounted for more simply by supposing the existence of a third opaque body perturbing the other two. Such bodies have already been suggested to account for irregular motions of apparently single stars, such as Sirius and Procyon. The body in this case, if supposed to circulate as a planet round the smaller star, need not be very large, as the deviation from the ellipse does not exceed about $0''\cdot1$. Assuming the small star to describe a secondary ellipse in which $a=0''\cdot08$, $\varepsilon=0''\cdot15$ and $\omega=200°$, and applying corresponding corrections to the computed positions, the average errors in the angles is reduced from $50'$ to $37'$, and in the distances measured subsequent to 1837, from $0''\cdot14$ to $0''\cdot11$, or by about $\frac{1}{4}$; while the maximum errors are also reduced in about the same proportion. There is, therefore, *prima facie* evidence for the existence of such a body, and it is desirable that the fact should be still further tested by careful observation. The subject possesses an additional interest at the present time, in reference to the opinion brought forward in the Essay "Of the Plurality of Worlds," on the *impossibility* of double stars having attendant planets. —*Proc. British Association.*

ON THE VARIABLE STARS CANCRI AND ALGOL.

M. Argelander has recently been devoting attention to the star *Cancri*, which has been found to undergo periodical fluctuations of brightness analo-

gous to those which distinguish the well known variable star *Algol.* On the 19th of December, 1852, he perceived the star when its light was very faint. The interposition of clouds prevented him from observing the precise instant of minimum brightness, and when the sky again cleared up, the light of the star had already sensibly increased. He is of opinion, however, that the period of variation as ascertained by him, viz., nine days, eleven hours, thirty-seven minutes, can not differ more than two minutes from the true value. All his observations of the star since February 16th, 1850, agree very well with this determination; but he has not yet succeeded in observing an exact minimum. As the star affords a visible minimum only every nineteen days, there is little hope of a single individual accomplishing much by means of such observations, and it were therefore desirable that other astronomers should direct their attention to this remarkable object. A five-foot Fraunhofer, or even a four-foot instrument with a dark sky, will suffice for this purpose, and the star is easy to find by means of its situation with respect to *Præsepe* and *Cancri.*

ON THE NUMBER OF THE DOUBLE STARS.

In the great work which Mr. Struve has lately published, containing the record of his labors on Double Stars at Dorpat, he gives, as the result of his careful examination and comparison of the whole body of facts in stellar astronomy, some conclusions of a novel character respecting the number and constitution of the double, or multiple stars. He examines especially the brighter stars—those comprised between the first and fourth magnitudes—and arrives at the conclusion that *every fourth star* of such stars in the heavens is physically double. He even ventures to assert that when we have acquired a more complete knowledge of double stars, it will be found that *every third* bright star is physically double. Applying these considerations to the stars of inferior orders of magnitude, he finally arrives at the following conclusion, which he admits to be of an unexpected character:—that the number of insulated stars is indeed greater than the number of compound systems; but only three times, perhaps only twice as great.

ON THE ADAMS'S PRIZE PROBLEM FOR 1857.

At the last meeting of the American Association Professor Peirce, of Harvard, submitted some remarks on the above subject. The problem has for its subject the Motion of Saturn's Rings, allowing them to be solid or fluid, concentric or eccentric. Professor Pierce disapproved much of this sort of prizes that wasted all the minds but one that were occupied with them, and still more so when they were limited to the graduates of a single university, as to that of Cambridge, England, in this instance. He reserved the consideration of solid rings of immovable parts for a meeting of the Mathematical section, when by use of formulæ he would prove it untenable. Can it be made up of a mass of satellite movable among themselves? Then they must be in continual motion among themselves, revolving among themselves about

their common centers of gravity; perpetual collisions ere this would have reduced them to powder. We assume now that the rings are fluid. Then they may vary in form. It was first shown that they had varied by Otto Struve. The diameter of the outer part of the ring is not known to have changed. The inner edge is contracting, as it seems to me. Huygens, in 1657, made it (allowing for the irradiation of his telescope) 6.5″. Huygens and Cassini, in 1695, made it 6″; Bradley, in 1719, 5.4″; Herschel, in 1799, 5″; Struve, senior, in 1826, 4.36″; Encke and Galle, in 1838, 4.04″; and Otto Struve, in 1851, 3.67″. Does it decrease uniformly? I think it is decreasing more rapidly, and the present rate will bring the ring to an end, in certain parts of it, in about 80 years from now. I will show in the meeting in section that the planet does nothing either to maintain or destroy the equilibrium of the ring. The satellites tend to maintain it in place. The ring is not gas; its density is nearly that of water. If the zodiacal light be a gaseous ring of the earth it would need some solid parts to give body to it. May that gas be the atmosphere around an infinity of small masses revolving about each other and about the earth? May there not be collisions among these revolving masses that throw down parts of them to the earth? Is not that as good a reservoir of meteors as the moon? Their melted state seems to lead us to a lunar volcanic origin; but unless some lunar volcano pointed expressly at the earth were put in furious operation, such a bombardment could not hit the earth with one in ten thousand of its projectiles.

The action of Saturn would tend to bring a solid inflexible ring against itself. But if almost the whole mass of the ring were gathered into a moon, leaving the rest a ring not worth the name, then it might revolve as a satellite, with the same side always toward the primary. The ring at all events *must* rotate around the planet in about ten hours, so that were it solid any inequality seen on one side would be on the other in about five hours. But it is often seen to have an inequality remain on the same side for a number of days. Now if the ring be liquid, it would revolve with a different velocity for different parts of the ring, so that a radius vector would pass over equal areas in equal times. Those parts in perigee, so to speak, would therefore be smaller and thinner in proportion to the velocity, and equal quantities of liquid would pass any point at all times. In this state the planet does nothing to sustain or destroy the equilibrium of the ring, but the attraction of the exterior satellites would tend to maintain its equilibrium.

The Adams's prize is from a fund established at Cambridge University, England, in honor of the English discoverer of the planet Neptune. The prize is to be given once in two years, for the best essay on some subject of pure mathematics, astronomy, or other branch of natural philosophy, the competition being open to all persons who have at any time been admitted to a degree in this university. The fund having been accepted by the university, the examiners announce the conditions of competition, and the method in which the subject is expected to be treated. The successful candidate receives about £130.

ON THE EARL OF ROSSE'S TELESCOPES, AND THEIR REVELATIONS IN THE SIDERIAL HEAVENS.

The following extract from a lecture delivered by the Rev. Dr. Scoresby, F. R. S., at Torquay, England, answers, to some extent, the question—What has the gigantic telescope of Lord Rosse effected?

The lecturer having himself had the privilege of observing, on different visits, and for considerable periods, with both the instruments, was enabled to reply, he hoped in a satisfactory manner, to this inquiry. His opportunities of observing, he said, notwithstanding interruptions from clouds and disturbed atmosphere, had been somewhat numerous, and, not unfrequently, highly instructive and delightful. Of these observations he had made records of nearly 60, on the moon, planets, double stars, clusters, and nebulæ. He had been permitted also to have free access to, and examination of, all the observatory records and drawings, so that he was enabled on the best grounds, he believed, to say that there had been no disappointment in the performance of the instruments; and that the great instrument, in its peculiar qualities of superiority, possesses a marvelous power in collecting light and penetrating into regions of previously untouched space. In what may be called the domestic regions of our planet—the objects in the solar system—all that other instruments may reveal is within its grasp or more, though by the prodigious flood of light from the brighter planets, the eye is dazzled unless a large portion is shut out.

But in its application to the distant heavens and exploration of the nebulous systems there, its peculiar powers have, with a steady atmosphere, their highest developments and noblest triumphs. In this department—that to which the instrument has been particularly directed—every known object it touches, when the air is favorable, is, as a general fact, exhibited under some new aspect. It pierces into the indefinite or diffuse nebulous forms shown by other instruments in a general manner, and either exhibits configurations altogether unimagined, or resolves, perhaps, the nebulous patches of light into clusters of stars. Guided in the general researches by the works of the talented and laborious Herschels—to whom astronomy and science owe a deep debt of gratitude—time has been economized, and the interests of the results vastly enhanced. So that many objects in which the fine instruments of other observers could discern only some vague indefinite patch of light, have been brought out in striking, definite, and marvelous configurations.

Among these peculiar revelations is that of the *spiral* form—the most striking and appreciable of all—which we may venture to designate "*The Rossean Configuration.*" Its discovery was at once novel and splendid; and in reference to the dynamical principles on which these vast aggregations of remote suns are whirled about within their respective systems and sustained against interferences, promises to be of the greatest importance.

One of the most splendid nebulæ of this class—the *Great Spiral* or *Whirlpool*—has been figured in the *Philosophical Transactions* for 1850. It may be considered as the grand type and example of a class; for near 40 more, with spiral characteristics, have been observed, and about 20 of them carefully

figured. Dr. Scoresby had the pleasure of being present at the discovery of this particular form in a nebula of the planetary denomination, in which two portions following spiral forms were detected. Its color was peculiar—pale blue. He had the privilege, too, of being present on another interesting occasion, when the examination of the great nebula in Orion was first seen to yield decisive tokens of resolution.

In these departments of research—the examination of the configurations of nebulæ, and the resolution of nebulæ into stars—the six-feet speculum has had its grandest triumphs, and the noble artificer and observer the highest rewards of his talents and enterprise. Altogether, the quantity of work done, during a period of about seven years—including a winter when a noble philanthropy for a starving population absorbed the keenest interests of science—has been decidedly great, and the new knowledge acquired, concerning the handiwork of the Great Creator, amply satisfying of even sanguine anticipations.

Dr. Scoresby found, in September last, that about 700 catalogued nebulæ had been already examined, and transferred to the ledger records from the journals of the Observatory (comprising only a selection from the general observations), and the *new nebulæ*, or nebulous knots, discovered merely incidentally, amounted to 140 or more. The number of observations, involving separate sets of the instrument, recorded in the ledger (exclusive of very many hundreds, possibly thousands, on the moon and planets), amount to near 1700, involving several hundreds of determinations of position and angular measurements with the micrometer on the far distant stars. The carefully drawn configurations, eliciting *new characteristics*, exceed 90, and the rough or less-finished sketches amount to above 200. Of the 700 catalogued nebulæ already examined, it should be observed that in full one half or more, something new has been elicited.

In speaking of the effects of the flood of light accumulated by the six-feet speculum of the Earl of Rosse, Dr. Scoresby remarked that this peculiarity of the instrument (connected as it is with due length of focus and admirable definition) enabled it to reach distances in space far beyond the powers of any other instrument. This was its peculiar province; and in this, as to existing instruments, there was not, nor, as he hoped to show, could there be, any competition. For comparing the space-penetrating power of the six-feet speculum with one of two feet (which has rarely been exceeded) we find it three to one in favor of the largest, with an accumulation of *light* in the ratio of 6^2 to 2^2, or 9 to 1. On comparing the powers of this magnificent instrument with those of a refractor of two feet aperture, the largest hitherto attempted, we have a *superiority*—making a due allowance for the loss of light by reflection from two mirrors, and assuming an equal degree of perfectness, figure, and other optical requirements in the refractor, and *no* allowance for absorption of light—in the ratio of about 4·5 to 1, as to light, and as 2·12 to 1 as to the capability of penetrating space, or detecting nebulous or siderial objects at the extreme distance of visibility. Hence, while the range of telescopic vision in a refractor of two feet aperture would embrace a *sphere* in space represented by a diameter of 2; the six-feet speculum (assuming both instruments to be of equal optical perfection, magnifying equally, and allow-

ing 50 per cent. for loss of light for two reflectors in the one case, and none (?) in the other) would comprehend a sphere of about 4·24 diameter—the outer shell of which, 1·12 in thickness, being the province of the great instrument alone. But let us reduce these proportions to *sections* of equal spaces, that we may judge more accurately of the relative powers. Now the solid contents of different spheres, we know, are in the ratio of the cubes of their diameters. Hence, the comparative spheres, penetrated by the two instruments referred to, should be $4{\cdot}24^3$ to 2^3; that is, as 9·5 to 1. Deducting, then, from this vast grasp of space the inner sphere, capable of being explored by other instruments, we find that, out of nearly ten sections of space reached by this telescope, there are nearly nine sections which the six-feet speculum may embrace as peculiarly its own!

What its revelations yet may prove, then, we can have no idea. Several thousands of nebulæ have been catalogued: the great reflector might add to these tens of thousands more. But this, seeing how few nights in a year are favorable for the highest powers, must be the work of years of perseverance. It would be a worthy undertaking for the government of a great country, to afford the means of multiplying such gigantic instruments. Application is to be made, in this direction, for a six-feet reflector at the Cape of Good Hope, for the examination of the heavens toward the southern pole. Lord Rosse, with his usual nobleness of liberality, will yield up his laboratory, machinery, and men, to the service of government, and is willing, moreover, to give the direction and guidance of his master-mind. Will the British nation be content with a refusal?

The range opened to us by the great telescope at Birr Castle, is best, perhaps, apprehended by the now usual measurement—not of distances in miles, or millions of miles, or diameters of the earth's orbit, but—of the progress of light in free space. The determination, within, no doubt, a small proportion of error, of the parallax of a considerable number of the fixed stars, yields, according to M. Peters, a space betwixt us and the fixed stars of the smallest magnitude, the sixth, ordinarily visible to the naked eye, of 130 years in the flight of light. This information enables us, on the principles of *sounding the heavens*, suggested by Sir W. Herschel, with the photometrical researches on the stars of Dr. Wollaston and others, to carry the estimation of distances and that by no means on vague assumption, to the limits of space opened out by the most effective telescopes. And from the guidance thus afforded us, as to the comparative power of the six-feet speculum in the penetration of space as already elucidated, we might fairly assume the fact, that if any other telescope now in use could follow the sun if removed to the remotest visible position, or till its light would require 10,000 years to reach us, the grand instrument at Parsonstown would follow it so far, that from 20,000 to 25,000 years would be spent in the transmission of its light to the earth. But in the cases of clusters of stars, and of nebulæ exhibiting a mere speck of misty luminosity, from the combined light perhaps of hundreds of thousands of suns, the *penetration* into space, compared with the results of ordinary vision, must be enormous; so that it would not be difficult to show the *probability* that a

million of years, in flight of light, would be requisite, in regard to the most distant, to trace the enormous interval.

But after all, what is all this, vast as the attainment may seem, in the exploration of the extent of the works of the Almighty? For in this attempt to look into space, as the great reflector enables us, we see but a *mere speck*—for SPACE IS INFINITE. Could we take, therefore, not the tardy wings of the morning, with the speed of the mere spread of day, nor flee as with the leaden wings of light, which would require years to reach the nearest star, but, like unhampered *thought*, could we speed to the furthest visible nebula at a bound, there, doubtless, we should have a continuance of revelations; and if bound after bound were taken, and new spheres of space for ten thousand repetitions explored, should we not probably find each additional sphere of telescopic vision garnished with suns and nebulous configurations, rich and marvelous as our own? If these views serve to enlarge our conception of creative wonders, and of the glory and power of the Great Architect of the heavens, should they not deeply impress us in respect to the Divine condescension in regarding so graciously this little, inferior world of ours! Animated with the spirit of the Psalmist, we shall each one surely be disposed appropriately to join in his emphatic saying: "When I *consider* Thy heavens, the work of Thy fingers, the moon and the stars which Thou hast ordained; what is man, that Thou art mindful of him? or the son of man, that Thou visitest him?"

ON THE ASTEROID PLANETS.

At the Providence Meeting of the American Association Professor Alexander, of Princeton, presented a paper on the character of the original asteroid planet. By a skillful use of evidence he has arrived at almost a certainty that in the space between Mars and Jupiter once revolved a planet a little more than 2·8 times as far from the sun as our earth. The equatorial diameter was about 70,000 miles, but the polar diameter only 8 miles! It was not a globe but a wafer, nay, a disk of a thickness of only 1-9,000 of its diameter. Its time of revolution was 3·698 days, say 3 days, 15 hours, 45 minutes. The inclination of its orbit to the ecliptic was about 4°. It met a fate that might have been anticipated from so thin a body wheeling so furiously, for its motion on its axis was 1-16th of its velocity in its orbit, say 2,477 miles per hour. It burst as grindstones and fly-wheels sometimes do. We have found 37 fragments of it and call them Asteroids. When it burst some parts were moving 2,477 miles per hour faster than the center did, and some as much slower; that is, some parts moved 4,954 miles per hour faster than the others. These described a much larger orbit than the planet did, and the place where it burst was their perihelion. Others described a smaller orbit, because they left that point with a diminished velocity—it was their aphelion. Some flew above the orbit of the planet and had their ascending node. Others flew below and it was their descending node. They seemed to go almost in pairs. Two went very far out of the plane of the orbit so that they pass the limits of the zodiac, and it is found that the ascending node of 18 correspond nearly with the descending node of 17. So nearly even were they distributed. And

thin as was the planet, it had not cooled so much at the time of the explosion but that some of the fragments could assume a spherical form. The following method of comparing the evidences was followed:

The planet's place was first to be found. Three or four independent processes were used for this and they agreed surprisingly. He interpolated it as a lost term in a geometric series, from Mars to Saturn, for the first approximation. He compared it with Saturn and Jupiter, and with Mars and Jupiter. He found where a planet would be dropped off in the successive cooling and contracting of the solar system. And he compared its orbit for size and ecliptieity with those of the asteroids. Some of them gave solutions very far from the average rejecting these; the others coincided with previous deductions and with each other surprisingly. Its day he found by Kirkwood's analogy. Its equatorial diameter was the result of two calculations, one of which would inevitably give a result too large and the other too small in all cases when the planet did not explode at its equinox, when it would be exact. These numbers were 78,425 and 68,656 miles. A just comparison gave 70,470.

It is curious to see how the history of this planet verifies the theory of La Place, that a heavenly body must be either nearly a sphere or a disk, and that the latter must be unstable. And this reminded Professor Alexander again to allude to the earth's ring—the zodiacal light. He had long been convinced that the moon could not be the only satellite thrown off by our planet in taking on its present form, but knew not where to look for the rest. A more careful calculation of the data furnished by the Reverend Mr. Jones, had given him for the diameter of the ring 17,000 miles, and a time of about half a day for rotation. And curiously enough half a day was the time that had been assigned by a previous calculation for the revolution of an aerolite around the earth.

EXTREME TEMPERATURE IN AUSTRALIA.

Mr. E. Merriam furnishes to the New York *Times* the following facts respecting the extreme heat recently observed in Australia. He says, "at the place of observation in the southern hemisphere, lat. 37° 48′ south, lon. 144° 57′ east, on the banks of the river Geelong, the maximum temperature thus far observed, was 120°, and minimum 24°—difference, 96°. On the 26th of October, 1854, the temperature rose to 115° at 3 P.M.; 4 P.M., 110°; 5 P.M., 80°, or a fall of 30° in 60 minutes, and next morning at five o'clock, 40°, or a change of 75° in 14 hours.

"My correspondent in a letter dated Monday, Januray 29, 1855, says: 'Yesterday was said to be a hotter day than the celebrated *Black Thursday* which occurred many years ago with a northern sirocco, and a hundred miles of brush on fire. People were driven to the water like cattle to preserve life—for the thermometer was at 118° nearly all day in the shade *and out of the wind.* In the wind it was at least 150°.'"

This extreme of natural heat is the greatest we believe, with one or two exceptions, which has ever been before recorded. On the west coast of Africa the thermometer has been observed to stand at 108° Fahrenheit in the

shade. Buckhard in Egypt and Humboldt in South America observed it at 117° Fahrenheit, and in 1819 it rose at Bagdad to 120° Fahrenheit in the shade.—*Editor.*

NEW THEORY OF THE WINDS.

At the meeting of the American Association, Providence, Captain Wilkes said he could not persuade himself that the theory of the winds, as at present accepted, is at all satisfactory. The theories seem to have resulted from the phenomena of the trade winds. He proceeded to show in what they are defective, and laid down the following axioms as the basis of a true explanation of the phenomena of the winds:

1. That the atmosphere, when of equal temperature and dryness, will remain at rest.
2. That if the atmosphere is disturbed by any change of temperature, the denser and colder portion seeks the warmer, from every direction, to restore the equilibrium.
3. That heated air, unless confined and forced, never tends toward a denser and cooler area; but when free it always rises or falls to the area, where its gravity and temperature will restore the equilibrium.
4. That currents of air may pass in opposite directions, without mixing, provided they lie according to their specific gravities, but they can never pass through or across each other without commingling.
5. That currents of air are influenced and disturbed by electricity.

Great stress has been laid, in the theory of the winds, on the rotary motion of the earth, in producing the direction as well as the apparent velocity of the trade winds. Captain Wilkes is not ready to admit that this can have any influence on any surface winds—in fact, the prevalence of westerly winds at the same time that we have easterly within the tropics moving in opposite directions, though parallel, demonstrates that the rotary motion of the earth can not have any such influence upon currents of air as is attributed to it.

MEDICAL METEOROLOGY AND ATMOSPHERIC OZONE.

An interesting communication on the above subject has recently been presented to the Meteorological Society of England by Dr. Moffat.

Since the discovery of ozone, in April, 1848, the subject has engaged the author's constant attention; from tables formed from the observations of four years, from 1850 to 1853, he seeks to establish a connection between atmospheric ozone and the meteorological conditions of the atmosphere, together with the prevalence of disease and mortality. The chief conclusions at which Dr. Moffat arrives are: 1st. That ozone periods always commence with decreasing readings of the barometer and increase of temperature, and terminate with increasing readings of the barometer and decrease of temperature. 2d. That as ozone periods commence very frequently with the wind in the south-east, and terminate in the north-west, those points adjacent to the south-east he calls their points of commencement, and those adjacent to the north-west,

those of their termination. 3d. That ozone and cirri always accompany each other, and would appear to be peculiar to the south or equinoctial current. The author therefore designates the south points of the compass as those of ozone and cirri, and the north or polar points those of no ozone and no cirri. 4th. That snow and thunderstorms take place generally in the south-east points, and during calms; while hail and auroræ are peculiar to the north-west points. 5th. That the maximum of disease occurs with the wind in the south points, and the maximum of mortality when in the north points. 6th. That some diseases are peculiar to certain directions of the wind. 7th. That apoplexy, epilepsy, paralysis, and sudden deaths are very common during hail and snow showers, and when the wind is in the points at which these phenomena generally occur—viz., the north-west and south-east. 8th. That ozone is in greater quantity on the coast than in inland districts. The author concludes by stating that owing to the action of light, and the influence of atmospheric currents in producing decomposition of the iodide of potassium, it is necessary, in order to secure uniformity of results, to place the test papers in darkness, and to keep them protected from atmospheric currents.

SATURN AND URANUS.

The following summary of the results of the labors of the distinguished astronomer, Mr. Lassell, at Malta, have been transmitted to the Royal Astronomical Society of England.

He says, "Excepting the transparency of the obscure ring of Saturn, perhaps my discoveries abroad were rather negative than positive. I ascertained, at least to my own conviction, that no other satellite exists about Neptune large enough to give hope of discovery without considerable improvement of our telescopes. Also, that while I was enabled most fully to confirm my discovery of the previous year, of two new and more interior satellites of Uranus, I arrived at an equally strong conviction that these two, together with the first two satellites simultaneously discovered by Sir W. Herschel in 1787, constitute the whole of the planet's retinue hitherto discovered. In the nebula of Orion I have, I believe, seen some minute stars in the neighborhood of the trapezium which are new. On the other hand, some of Mr Bond's stars I have not been able to make out. A comparison of Sir John Herschel's, Mr. Bond's, and my own drawings of this wonderful object must, I think, suggest the idea of change in the nebula, or variability of the stars, or otherwise, a less uniformity of delineation of the same thing than might have been hoped for."

NOTE ON THE EXTENT OF OUR KNOWLEDGE RESPECTING THE MOON'S SURFACE.

Taking advantage of the special attention paid at present to certain astronomical disquisitions, the author called attention to a particular point connected with the moon, which was first stated by the author of "The Plurality of Worlds," and then made by him to prove that the moon must be uninhabited,

and thence to lead to the conclusion that all the other planets were uninhabited also. The point was, that "observations having been made on the moon abundantly sufficient to detect the change caused by the growth of such cities as Manchester and Birmingham, no such changes having been perceived, the theory of non-habitation may be indulged in." But after having indicated the sort of appearance that those collections of human habitations would make when transferred to the moon, Professor Smyth proceeded to show that the registered and published observations of the moon are by no means sufficiently accurate to be used to test question: and that they do show changes, and often to a far greater amount than the mere building of a lunar Manchester would occasion, but such changes bear the impress of error of observation. More powerfully still was this brought out, on comparing even the best of the published documents with some manuscript drawings of the Mare Crisium in the moon, recently made at the Edinburgh Observatory, and the author hoped that this statement of the imperfection of existing maps would lead to observers generally applying themselves to improve this important and interesting field of astronomy.—*Professor C. Piazzi Smyth.*

PATENTS.

PATENTS, DESIGNS, REISSUES, AND ADDITIONAL IMPROVEMENTS GRANTED BY THE PATENT OFFICE OF THE UNITED STATES DURING THE YEAR 1854.

Patents	1,871
Designs	71
Reissues	46
Additional Improvements	11
Total	1,999

The above is the greatest number of patents, etc., ever issued in one year from the office.

Mr. J. S. Brown, of Washington, has recently published a catalogue of all the patents granted by the United States Government up to the commencement of the year 1855. From this we learn that the whole number of patents granted for *Grain and Grass Harvesters* has been one hundred and eleven; for *Plows*, three hundred and seventy-two; for *Straw-Cutters*, one hundred and fifty-three; for *Smut machines*, one hundred and forty; for *Winnowing machines*, one hundred and sixty-three, and for *Thrashing machines*, three hundred and seventy-eight. The highest numbers in classes belong to the agricultural department, with the exception of Stoves, on which the enormous number of six hundred and eighty-two patents have been issued, and four hundred and seventy-eight for designs, making a total of one thousand one hundred and sixty patents on Stoves.

On Air Engines, not one of which is in use, no less than twenty-one patents have been granted. No less than one hundred and forty-eight patents have been granted on Steam Boilers; and yet, for all this, there are but few engineers who do not entertain the opinion that many improvements have yet to be made on them. The manufacture of India-rubber goods is but of recent date, and yet no less than forty-two patents have been obtained on such manufactures. Sewing machines are of still more recent date, the first patent having been obtained in 1846, only nine years since; and yet no less than sixty patents have been granted on such machines. This affords evidence of their popularity and usefulness. The number of Water-wheel patents is somewhat high, being three hundred and twenty-seven, but that of Washing machines comes nearly up to it, being no less than three hundred and nine.

OBITUARY

OF PERSONS EMINENT IN SCIENCE. 1855.

K. F. Bachmann, a German mineralogist, Professor in the University of Jena.
Martin Barry, M.D., an English physiologist.
Sir Henry de la Beche, the well known English geologist.
Dr. T. Romeyn Beck, of Albany, N. Y.

Edward Bourne, an eminent English engineer and naval architect.

M. Braconnet, an eminent French chemist, the discoverer of xyloidine, pyrogallic acid, etc., etc.

Major T. S. Brown, the constructing engineer of the New York and Erie Railroad, and chief engineer of the Moscow and St. Petersburg Railroad, Russia.

W. H. Brown, an eminent American ship-builder, constructor of the Atlantic, Pacific, and other steamers.

Professor Busch, director of the Observatory at Königsberg.

Col. John C. Champion, an English naturalist, killed at the siege of Sebastopol.

M. Charpentier, an eminent Swiss geologist and naturalist.

Professor Cowper, Professor of Materia Medica, University of Edinburg.

Andrew Crosse, an enthusiastic amateur of science, well known for his electrical experiments, and asserted creation of insect life by galvano-electricity.

Ernst Dieffenbach, the well known geological Professor at Giessen, Germany.

Louis Weston Dillyne, an English naturalist.

George Louis Duvernoy, Professor of Comparative Anatomy, Jardin des Plantes, Paris.

Horace Eaton, Professor of Chemistry, Middlebury College, Vermont, and formerly Governor of that State.

John Graem Ellery, an American geologist and mining engineer.

Charles Frederick Gauss, the eminent German astronomer and mathematician.

S. B. Greenough, an English geologist.

Dr. John Gorrie, of Florida, a well known American inventor.

J. H. Gould, an English naturalist, died in India.

James F. W. Johnson, the distinguished English agriculturist and scientific writer.

Abbot Lawrence, founder of the Lawrence Scientific School, Cambridge, Mass.

Henry Lawson, an English astronomer and patron of science.

Leonard Maelzel, the inventor of the automaton chess-player, and other curious mechanical arrangements.

M. Magendie, the eminent French physiologist and naturalist.

M. De Mayer, a Russian naturalist and traveler.

Sandy McCallum, a celebrated collector of fossils in Scotland.

Robert Mills, of Washington, D. C., architect of the Washington Monument, and various national structures.

Dr. Molkenboer, a Dutch naturalist of Leyden, Holland.

Count Ouwaroff, formerly President of the Royal Academy of Sciences, Russia.

Sir Edward Parry, the distinguished Arctic navigator.

Professor Petrina, of the University of Prague.

Philip Pusey, President of the Royal (English) Agricultural Society, and a most eminent agriculturist.

Dr. Ratkhe, Professor of Natural History, University of Christiana, Norway.

Ernst Reinholdt, Professor of Philosophy, Jena, Prussia.

Joseph Remy, the French fisherman who first introduced the artificial propagation of fish.

W. D. Saull, an English geologist.

Simeon L. Spofford, an American railroad engineer and inventor.

Dr. Edward Stolle, a distinguished German technologist.

F. Strange, an eminent English ornithologist, murdered by the natives of Australia.

Dr. William Terrel, an eminent American agriculturist and patron of science.

Thomas Weaver, an English geologist.

William Wing, Secretary of the English Entomological Society.

LIST OF BOOKS, PAMPHLETS, ETC.,

ON MATTERS PERTAINING TO SCIENCE, PUBLISHED IN THE UNITED STATES DURING THE YEAR 1855.

Annals of the Astronomical Observatory of Harvard College, Vol. I. Part II., 1852–53, pp. 316.

Bache, A. D. Report of the Coast Survey for 1854.

Bache, A. D. Tide Tables for the principal sea-ports of the United States. Pamphlet.

Buchman, Reverend John. An examination of the Natural Provinces of the Animal World, and their relations to the different types of Mankind. James & Co., Charleston, S. C.

Baird, S. F. Report on the Fishes of the New Jersey Coast. Smithsonian publication.

Bartlett, Professor W. H. E. Elements of Natural Philosophy. A. S. Barnes & Co., N.Y.

Beckwith, Lieutenant. Report on the projected Pacific Rail-road Route, near the 38th and 39th parallels of latitude. Pub. Doc.

Bell, John. Mineral and Thermal Springs of the United States and Canada. 12mo. Parry & M'Millan, Philadelphia.

Blake, William P. Report on the geological features of Williamson's Pacific Rail-road Survey. Pub. Doc.

Breed and Steiner, Doctors. Wills's Outlines of Chemical Analysis. Re-edited. Munroe & Co., Boston.

Burt, W. A. The Solar Compass.

Chapman, Dr. L. L. Principia, or Nature's first principles. Campbell & Co., Philadelphia.

Cole, George, and Vernam, J. S. The Contractor's Book of Drawings of tools and machines used in constructing canals, rail-roads, and other works. Folio. O. G. Steele & Co., Buffalo, N. Y.

Dana, James D. Report on Crustacea—the Atlas. This volume forms one of the series of the Reports of the United States Exploring Expedition, and contains 96 plates in folio, with figures and details of nearly 700 species, from drawings by the author. G. P. Putnam & Co., 321 Broadway, N. Y.

Dana, Samuel L. Muck Manual. New and enlarged edition. Saxton & Co., N. Y.

Darby, Professor John. Botany of the Southern States. In two parts. Part I. Structural and Physiological Botany and Vegetable Products. Part II. Description of Southern Plants, arranged on the natural system. Preceded by a Linnæan and a Dichotomous Analysis. A. S. Barnes & Co., New York.

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De Gobineau. The Moral and Intellectual Diversity of Races. From the French of De Gobineau. By H. Hotz. With an Appendix, containing a summary of the latest scientific facts bearing upon the question of Unity or Plurality of Species, by J. C. Nott, M.D. 8vo. Lippincott & Co., Philadelphia.

De Vere, M. S. Stray Leaves from the Book of Nature. G. P. Putnam & Co., New York.

Ellet, Charles, jr. Coast and Harbor Defenses.

Emmons, Ebenezer, M.D. American Geology, with illustrations of characteristic American Fossils. Atlas and Geological Map. 1 vol. pp. 445. Sprague & Co., Albany, N. Y.

Ewbank, Thomas. The World a Workshop, or the Physical Relations of Man to the Earth. pp. 198. Appleton & Co., New York.

Fitch, Asa, M.D. First Report on the Noxious, Beneficial, and other Insects, of the State of New York.

Flint, C. L. Second Annual Report of the Massachusetts State Board of Agriculture.

Gillis, Lieutenant J. M. United States Naval Astronomical Expedition to the Southern Hemisphere, during the years 1849, 1850, 1851, 1852. 2 vols. Lippincott & Co., Phil.

Gurley, W. and L. E. Manual of the Instruments used in Engineering and Surveying Troy, N. Y.

Hardwick, T. F. Manual of Photographic Chemistry. American edition. Re-edited by S. D. Humphrey, New York.

Lapham, J. H. A Geological Map of Milwaukie, Wisconsin.
Lea, Isaac, LL.D. Fossil Foot-marks of the Red Sandstone of Pottsville, Penn. Folio.
Lehman's Physiological Chemistry. Edited, with illustrations, by Professor R. E. Rogers, University of Pennsylvania. Blanchard & Lea, Philadelphia.
Liebig, Justus. The Relations of Chemistry to Agriculture, and the Agricultural Experiments of J. B. Lawes. Translated by S. W. Johnson, Albany, New York. Luther Tucker & Co. Price 25 cents.
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Loomis, Elias. An Introduction to Practical Astronomy. Harpers, New York.
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Parke, Lieutenant John C., U. S. A. Report on the projected Pacific Rail-road Route on the 32d parallel. Pub. Doc.
Parrish, Edward. An Introduction to Practical Pharmacy. 8vo. pp. 550. Blanchard & Lea, Philadelphia.
Perceval, Dr. J. S. Report on the Iron Ore of Dodge and Washington Counties, Wisconsin.
Perry, J. R. Stair-Building. A. H. Ranney. New York.
Photography, Theoretical and Practical. Heath & Brother, New York.
Proceedings of the American Association for the Advancement of Science. 8th meeting. Washington, D. C.
Proceedings of the National Institute. Washington, D. C. Vol. I. No 1. New series.
Ranking's Half-yearly Abstract of the Medical Sciences. 8vo. pp. 310. Lindsay & Blakiston, Philadelphia.
Report of the Commissioner of Patents for 1854, Mechanical and Agricultural.
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Report, Sixty-eighth Annual, of the Regents of the State of New York.
Smith, Professor J. Laurence. Report on the Minerals and Mineral Waters of Chili.
Stevens, J. J. Report on the projected Route for the Pacific Rail-road near the 47th and 49th parallels. Pub. Doc.
Trask, Dr. John. Report on the Geology of the Coast Mountains of California. Pamphlet. Sacramento, California.
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Waring, George E. Elements of Agriculture: a Book for Young Farmers. Appleton & Co., New York.
Wells, David A. Annual of Scientific Discovery for 1855. Gould & Lincoln, Boston; G. P. Putnam & Co., New York.
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Wetherill, C. M., Dr. Adipocere and its Formation. Philadelphia.
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Williamson, Lieutenant. Reconnoissance and Survey in California in connection with the projected Pacific Rail-road. Pub. Doc.
Youmans, Edward L. Chemical Atlas; or, the Chemistry of Familiar Objects. Imp. 4to. pp. 106. D. Appleton & Co., New York.

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